Schena, Cristeen

From: Flores, Priscilla (Feliciano)
Sent: Tuesday, March 03, 2015 9:53 AM
To: Dahl, Donald
Subject: RE: Copy of our response
Attachments: R1-15-000-4093.pdf

Hi Donald,

As requested.

Priscilla

From: Dahl, Donald
Sent: Tuesday, March 03, 2015 9:42 AM
To: Flores, Priscilla (Feliciano)
Subject: Copy of our response

Hi Priscilla do you have a copy of the letter we sent to Save our Sound at the end of January. The control number is R1-15-000-4093. I need the date of the letter for a new control correspondence I am working on. Thanks.

Donald Dahl
Air Permits
EPA New England
(617) 918-1657

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
5 POST OFFICE SQUARE, SUITE 100
BOSTON, MA 02109-3912

OFFICE OF THE
REGIONAL ADMINISTRATOR

January 29, 2015

Ms. Audra Parker
President and CEO
Save Our Sound
4 Barnstable Road
Hyannis, MA 02601

Dear Ms. Parker:

Thank you for your December 19, 2014, letter regarding the EPA Permit Number OCS-R1-01 issued to Cape Wind Associates (CWA) on January 7, 2011.

EPA's permit covers the "Project Area" shown in Figure 1 of CWA's December 17, 2008 application. (See epa.gov/ne/communities/pdf/CapeWind/CapeWindOCSPermitApplication2008December17.pdf.) At this time, CWA has not provided EPA with a request to amend its permit for activities within the project area. We have reviewed the possibility of the project's staging area changing from Quonset Point, Rhode Island to New Bedford, Massachusetts and the impact such a change would have, if any, on the terms and conditions of the permit. Because changing the location of the staging area does not change CWA's compliance with the permit conditions, we have concluded that reopening the permit is not warranted by this possible change. If CWA requests a permit amendment or provides additional information regarding changes to the project within the Project Area, EPA will then review any potential impact the new information may have on the permit.

Again, thank you for your letter. If you have any questions or comments, please contact either Ida McDonnell at (617) 918-1653 or Donald Dahl of my staff at (617) 918-1657.

Sincerely,

H. Curtis Spalding
Regional Administrator

Schena, Cristeen

From: McVay, Doug (DEM) <doug.mcvay@DEM.RI.GOV>
Sent: Thursday, January 29, 2015 8:54 AM
To: McCoy, Angel
Cc: Dahl, Donald;Gold, Ruth (DEM)
Subject: RE: Available Emission Offsets in Rhode Island for the Cape Wind Project
Attachments: EPA comments 08092013_Cape Wind Energy Project General Conformity.docx; DOE Comment letter.doc

Angel-

Our records indicate there are roughly 46 tons/year of NO_x offsets available in RI. In terms of options if enough offsets are not available, the two letters I have attached (one from RI DEM and one from EPA) summarize the available options.

Feel free to call or e-mail me with any questions or to discuss.

Doug McVay, Chief
Office of Air Resources
RI Dept of Environmental Management
235 Promenade Street
Providence, RI 02908
Phone: 401-222-2808, x-7011
Fax: 401-222-2017

From: McCoy, Angel [mailto:angel.mccoy@boem.gov]
Sent: Monday, January 26, 2015 3:04 PM
To: McVay, Doug (DEM); Dahl, Donald
Subject: Available Emission Offsets in Rhode Island for the Cape Wind Project

Hello Doug and Donald,

Actually, Donald and I already know each other, so this little introduction is more for you Doug.

I am from BOEM's Office of Renewable Energy Programs. I am the subject matter expert for air quality. I am contacting you today because I have heard rumors that Cape Wind no longer has the emission offsets available for their currently proposed staging activities out of Quonset Point, RI. In 2009, the Final General Conformity Determination concluded that

"The estimated emissions from the Cape Wind Project were not specifically identified or accounted for in the SIP. As a result, 139.4 tons of NOx emissions would need to be offset in Year 1. No emission offsets are needed for Year 2 since emissions are below the threshold for conformity. The quantity of available offsets in Rhode Island is extremely limited. Currently there are 259.9 tons per year of banked NOx available in Rhode Island (McVay, 2009). This would be sufficient to cover the emissions from Cape Wind. However, there are potential transactions that could reduce this figure to 124.9 tons per year (McVay, 2009). This would leave 14.5 tons per year that would still have to be mitigated."

I would like to know, howmany tons of banked NOx are still available and what are our other options if there are not enough available?

I hope that you are the proper points of contact, if not, please point me in the right direction and I thank you for your time.

Angel

--

Angel M. McCoy

Meteorologist, Environmental Branch

Office of Renewable Energy Programs

Bureau of Ocean Energy Management

703-787-1758

Angel.McCoy@boem.gov

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

August 9, 2013

Mr. Todd Stribley
Environmental Compliance Officer
U.S. Department of Energy, Loan Programs Office, LP-10
100 Independence Ave, SW
Washington, DC 20585

Re: Draft General Conformity Determination for the Cape Wind Energy Project

Dear Mr. Stribley:

Thank you for the opportunity to comment on your July 3, 2013 letter. In your letter, you identified the U.S. Department of Energy's (DOE's) independent review of the analysis, assumptions, and conclusions in Bureau of Ocean Energy Management's (BOEM's) *Final General Conformity Determination* issued in December 2009. According to your letter, DOE has adopted BOEM's December 2009 Cape Wind Conformity Determination which relies on purchase of offsets or a combination of offsets and emission control measures to satisfy general conformity in Rhode Island.

EPA is aware, from a telephone conversation with Doug McVay, Chief, Office of Air Resources, Rhode Island Department of Environmental Management, that emission reductions identified in 2009 may no longer be available for the Cape Wind Project. In fact, of the 140 tons needed in the first year of construction, only 20 to 30 tons of emission offsets may actually be available in Rhode Island.

However, April 5, 2010 amendments to the General Conformity Regulations allow Federal agencies to obtain emission offsets for general conformity purposes from another nearby nonattainment or maintenance area of equal or higher nonattainment classification, provided the emissions from that area contribute to violation of the NAAQS in the area where the Federal action is located or, in the case of maintenance areas, the emissions from the nearby area contributed in the past to the violations in the area where the Federal action is occurring. (See April 5, 2010; 75 FR 17266 and 40 CFR 93.158.) This flexibility may benefit BOEM and DOE in satisfying their required offsets and mitigation to satisfy general conformity.

Also, we would like to emphasize that once a project triggers general conformity, <u>all</u> direct and indirect emissions must be fully offset (or otherwise satisfy general conformity), pursuant to 40 CFR 93.158. Project mitigation to reduce project emissions in a specific year such as through add-on control systems for diesel engines to a level below the general conformity thresholds in 40 CFR § 93.153 does not by itself satisfy conformity. All project emissions projected (approximately 140 tons expected in the first year of construction) must be offset pursuant to 40 CFR § 93.158.

Finally, and perhaps most importantly, we note that on June 6, 2013 (78 FR 34178), in its proposed implementation rule for the 2008 ozone National Ambient Air Quality Standard (NAAQS), the EPA is also proposing the revocation of the 1997 ozone NAAQS. This rulemaking is currently open for comment until September 4, 2013 (July 24, 2013; 78 FR 44485). We expect the final rule to be issued in the Spring 2014 time frame. ***General conformity for ozone will not apply in Rhode Island after the revocation of the 1997 ozone NAAQS***, since the entire state of Rhode Island is attainment for the 2008 ozone NAAQS. Should revocation of the 1997 ozone standard occur prior to the time when BOEM and DOE "take or start the Federal action,[1]" the lead agencies may wish to re-open and re-evaluate their general conformity determinations with respect to ozone.

If you have any questions regarding our comments, please contact Donald Cooke at (617) 918-1668, cooke.donald@epa.gov .

Sincerely,

Anne E. Arnold, Manager
Air Quality and Planning Unit

cc: Doug McVay, RIDEM

[1] "Take or start Federal action" is defined in the general conformity regulations at 40 CFR 93.152 as the date that the Federal agency signs or approves the permit, license, grant or contract or otherwise physically begins the Federal action that requires a conformity evaluation under this subpart.

8 August 2013

Todd Stribley
U.S. Department of Energy
Loan Programs Office, LP-10
1000 Independence Ave, SW
Washington, DC 20585

Dear Mr. Stribley:

The Rhode Island Department of Environmental Management's Office of Air Resources offers the following comments on the U.S. Department of Energy's (DOE) draft General Conformity Determination for the Cape Wind Energy Project.

DOE has adopted the Bureau of Ocean Energy Management's Final General Conformity Determination issued in December 2009 as its draft General Conformity Determination for a possible loan guarantee to Cape Wind Associates, LLC. The 2009 General Conformity Determination states that there are between 124.9 and 259.9 tons per year of banked nitrogen oxides (NO_x) emission reductions available in Rhode Island that could be used to offset the 139.4 tons of NO_x emissions associated with Quonset Point port operations and vessel transit.

Be advised that the quantity of banked NO_x emission reductions available in Rhode Island is currently less than 24 tons per year. This quantity is not sufficient to offset Cape Wind construction activities in Rhode Island. As a result it is likely Cape Wind Associates will need to implement one of the alternative mitigation measures identified in their September 4, 2009 letter to James F. Bennett (Appendix B of the General Conformity Determination). These mitigation measures could include:

- Reducing the NO_x emissions in Rhode Island resulting from the project's construction activities below the conformity threshold by reducing the activity levels of emission sources and/or by utilizing sources equipped with air pollution control equipment to reduce NO_x emissions, or;

- Acquiring the required emission offsets from another state. On April 5, 2010, EPA revised the General Conformity Regulations to allow emission offsets to be obtained from a nearby nonattainment area of equal or higher classification provided the emissions from that area contribute to violation of the National Ambient Air Quality Standard in the area where the offsets are needed. (see 40 CFR 93.158(a)(2))

Thank you for the opportunity to comment on the draft General Conformity Determination. If you have any questions on our comments, you can contact me at (401)-222-2808, x-7011 to discuss.

Sincerely,

Douglas L. McVay
Chief, Office of Air Resources

cc: Donald Cook – EPA Region 1
Ida McDonnell – EPA Region 1

Schena, Cristeen

From: McCoy, Angel <angel.mccoy@boem.gov>
Sent: Monday, January 26, 2015 3:04 PM
To: doug.mcvay@dem.ri.gov;Dahl, Donald
Subject: Available Emission Offsets in Rhode Island for the Cape Wind Project

Hello Doug and Donald,

Actually, Donald and I already know each other, so this little introduction is more for you Doug.

I am from BOEM's Office of Renewable Energy Programs. I am the subject matter expert for air quality. I am contacting you today because I have heard rumors that Cape Wind no longer has the emission offsets available for their currently proposed staging activities out of Quonset Point, RI. In 2009, the Final General Conformity Determination concluded that

"The estimated emissions from the Cape Wind Project were not specifically identified or accounted for in the SIP. As a result, 139.4 tons of NOx emissions would need to be offset in Year 1. No emission offsets are needed for Year 2 since emissions are below the threshold for conformity. The quantity of available offsets in Rhode Island is extremely limited. Currently there are 259.9 tons per year of banked NOx available in Rhode Island (McVay, 2009). This would be sufficient to cover the emissions from Cape Wind. However, there are potential transactions that could reduce this figure to 124.9 tons per year (McVay, 2009). This would leave 14.5 tons per year that would still have to be mitigated."

I would like to know, howmany tons of banked NOx are still available and what are our other options if there are not enough available?

I hope that you are the proper points of contact, if not, please point me in the right direction and I thank you for your time.

Angel

--

Angel M. McCoy

Meteorologist, Environmental Branch

Office of Renewable Energy Programs

Bureau of Ocean Energy Management

703-787-1758

Angel.McCoy@boem.gov

Schena, Cristeen

From: Flores, Priscilla (Feliciano)
Sent: Tuesday, January 20, 2015 1:09 PM
To: Dahl, Donald
Subject: RE: Looking for a letter Curt signed
Attachments: R1-15-000-0654.pdf

As requested.

Priscilla

From: Dahl, Donald
Sent: Tuesday, January 20, 2015 12:37 PM
To: Flores, Priscilla (Feliciano)
Subject: Looking for a letter Curt signed

Hi Priscilla, I was hoping you could send me a copy of a letter Curt sent to Save our Sound on 11/5/2014. I was responsible for writing the letter (it was a control correspondence) but I cannot locate a signed copy.

Donald Dahl
Air Permits
EPA New England
(617) 918-1657

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
5 POST OFFICE SQUARE, SUITE 100
BOSTON, MA 02109-3912

OFFICE OF THE
REGIONAL ADMINISTRATOR

November 5, 2014

Ms. Audra Parker
President and CEO
Save Our Sound
4 Barnstable Road
Hyannis, MA 02601

Dear Ms. Parker:

Thank you for your October 15, 2014, letter regarding EPA Permit Number OCS-R1-01 issued to Cape Wind Associates (CWA) on January 7, 2011. EPA is aware of recent newspaper articles claiming that New Bedford, Massachusetts may be used as the staging area for the wind turbine project instead of or in addition to Quonset, Rhode Island.

At this time, CWA has not provided EPA with any amendment to its CAA permit nor provided any information regarding staging the project from New Bedford. If CWA were to request a permit amendment or provide additional information regarding staging areas, EPA would then review any potential impact the new information may have on the Outer Continental Shelf Air Permit.

Again, thank you for your letter. If you have any questions or comments, please contact Ida McDonnell at (617) 918-1653.

Sincerely,

H. Curtis Spalding
Regional Administrator

Schena, Cristeen

From: Dahl, Donald
Sent: Monday, January 05, 2015 3:22 PM
To: 'Rachel Pachter'
Subject: Letters between NOAA and BOEM
Attachments: Dec 23 2014 letter to BOEM Atlantic sturgeon concurrence.pdf; Dec 23 2014 letter to BOEM re COP revisions.pdf

See attached.

Donald Dahl
Air Permits
EPA New England
(617) 918-1657

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

DEC 2 3 2014

Michelle Morin
Chief, Environment Branch for Renewable Energy
U.S. Department of the Interior
Bureau of Ocean Energy Management
Washington, D.C. 20240-0001

Re: Cape Wind Energy Project, Request for Concurrence in Finding of Not Likely to Adversely Affect for the Atlantic Sturgeon

Dear Ms. Morin,

In response to your September 9, 2014 letter, we concur with the Bureau of Ocean Energy Management's (BOEM) determination that the construction, operation and decommissioning of the Cape Wind Energy Facility is not likely to adversely affect the Atlantic sturgeon.

Atlantic Sturgeon Listing

As you know, on October 6, 2010, we issued proposed rules to list five Distinct Population Segments of Atlantic sturgeon as threatened (Gulf of Maine DPS) and endangered (New York Bight, Chesapeake Bay, Carolina and South Atlantic). Final listing rules were published on February 16, 2012 (77 FR 5880 and 5914).

The December 30, 2010 Biological Opinion (Opinion) that we previously issued on the Cape Wind project pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended, did not consider potential effects on the Atlantic sturgeon because the listing of that species had not been finalized and become effective at the time consultation was completed.

As we explain below, we have determined that any effects of the Cape Wind project on the Atlantic sturgeon will be insignificant and/or discountable. Therefore, we concur with your determination that BOEM's proposed action is not likely to adversely affect the Atlantic sturgeon. No incidental take of Atlantic sturgeon from any DPS is anticipated. Because BOEM's proposed action is not likely to adversely affect the sturgeon, it is not necessary for us to produce a new Biological Opinion to incorporate these conclusions. 50 CFR 402.14(b).

As of the date of this consultation, certain portions of the project already have been completed (*i.e.*, pre-construction geotechnical and geophysical surveys). As such, we consider here potential impacts from the planned construction, operation and decommissioning of the wind turbines, associated electrical cables and platform, as well as vessel traffic, as recently amended.

The Proposed Action, As Amended

A complete description of the proposed action is included in the 2010 Opinion. We incorporate that description by reference. On July 25, 2014, Cape Wind Associates (CWA) filed a Facilities Design Report and Fabrication and Installation Report (FDR/FIR) and revised Construction and Operations Plan (COP) with the Bureau of Ocean Energy Management (BOEM). With the exception of what is described below, the proposed action remains as it was described in the December 30, 2010 Opinion.

Timing of Construction

In the 2010 Opinion, we stated that construction was planned to take place over a 5-9 month period between April and November, the full period of which would result in construction occurring over two seasons. CWA has provided BOEM with additional details on the construction schedule that clarify when different activities will take place. In the July 2014 COP, CWA states that the monopiles to support 101 turbines would be installed during the first season of construction ("Season A", currently scheduled to occur between April and August 2015). During the second season, the remaining 29 monopiles will be installed ("Season B", commencing after April 2016). Installation of scour protection will follow monopile installation in the same year. Intra-array cable installation would also occur in the same year as monopile installation. Submarine cable installation (connection to shore) would occur in the second construction season (2016). In-water construction work for the Electrical Service Platform (ESP) is currently scheduled for the first season with topside work scheduled for the second season.

Inner-Array Cable Route

CWA has made minor modifications to the inner array cable routing. In addition, the total length of the cable route is increased to 70 miles from 66.7 miles, an increase of approximately 3.3 miles. The inner array cable route is illustrated in Figure 1. As illustrated in Figure 1, cable installation will occur in two construction seasons.

Electrical Service Platform Design

The ESP's fixed template-type jacket frame foundation system has been revised from the originally proposed single, large, jacket frame anchored with six driven foundation piles to an updated design that requires two smaller, separate, jacket frames, each anchored with four driven foundation piles (for a total of eight piles). The diameter of the piles (approximately 42") remains unchanged. The COP (p. 84) describes the installation of the ESP jackets as follows: "The jacket will be transported to the site on a jack up transport barge. Once on site, the jacket is expected to be lifted from the transport barge by a crane mounted on a separate jack up barge." The jackets will be installed from a floating barge rather than a jack up barge. The topside installation procedure is a float-over and remains as described in the COP.

The dimensions of the ESP have also changed. The ESP will be smaller (132' x 115' (15,180 square feet); compared to 100' x 200' (20,000 square feet) as originally planned) and will not rise as far off the water. The first deck will be approximately 35' above MLLW and rise 47' to the roof compared to the original design of the first deck of the ESP to be approximately 39' above MLLW and rising 49' to the roof. CWA is also planning to install three rather than four transformers at the ESP, with a total of 30,000 gallons of transformer cooling oil (compared to 40,000 gallons originally considered).

Pile Installation

In their FDR/FIR, CWA describes the types of impact hammers to be used for pile driving during the installation of turbine foundations and ESP jacket foundations. CWA plans to use an IHC S-1800 hydrohammer, a Menck 1900S impact hammer or an equivalent hydraulic impact hammer with a comparable energy rating to drive the piles to grade.

BOEM will require CWA to employ a noise attenuation system (NAS) during pile driving operations to ensure that: the radius of the 180 dB re 1uPa peak isopleth does not extend beyond 750 m; the radius of the 160 dB re 1uPa RMS isopleth does not extend beyond 3.4 km during impact pile driving; and, the radius of the 120 dB re 1uPa RMS isopleth does not extend beyond 3.4 km during vibratory pile driving. CWA is proposing to use a large bubble curtain system as a noise attenuation system (NAS) for all pile driving. Sound source verification will be required for the first pile installed with the impact hammer and the first time a vibratory hammer (see below) is used. While unexpected, if the size of these isopleths is greater than these distances, BOEM will require CWA to employ additional mitigations that are effective in achieving the required reductions. BOEM confirms that should an additional sound barrier be needed, the bubble curtain system has the inherent flexibility to accommodate this requirement; that is, it is possible to add a second layer of bubbles.

BOEM estimates that while specific actual installations will vary in performance, a single bubble curtain is predicted to reduce noise levels by 8-14 dB (peak). This prediction is considered to be an effective quantification of relative performance to evaluate pile installations (Stokes *et al.*, 2010). A report published by the German Federal Agency for Nature Conservation (2013) documents that reductions of 8-14 dB (peak) were achieved with the single ring bubble curtain in water depths from 23-33 m.

The bubble curtains act as a direct reduction of the source level. Assuming standard 20 log(R) spherical spreading (as described in BOEM's effects analysis this is a reasonable assumption considering the relatively shallow depths and short distances being discussed), a single bubble ring will result in noise levels as described in Table 1.

Boulder Mitigation

Geotechnical and geophysical investigations on the Project Site have confirmed that the site is potentially populated with a variety of large glacial erratics (boulders) on the surface of and in the top 10 m of the soil matrix. In the event that a boulder is encountered during the installation of a monopile, CWA has proposed the use of four possible methodologies to mitigate for boulders: driving through a boulder with the impact hammer, use of a vibratory hammer, clamshell extraction or drilling through the boulder.

Driving through a boulder with the impact hammer

Foundation monopiles are designed to be driven to full penetration with a hydraulic impact hammer. If a boulder is encountered during driving, the selected hammer may drive through the boulder. According to BOEM, this has been successfully done on European projects.

Vibratory hammer

Test installations have been done using vibratory hammers on European offshore wind projects (de Neef *et al.*, 2013) and more are in progress (RWE Innogy, 2014). BOEM states that fatigue analysis has shown that using the vibratory hammer is within the foundation design standards and will allow multiple attempts of re-driving the pile. A pile that is partially driven and blocked by a boulder could be extracted by the vibratory hammer and moved to a new location. Further engineering analysis is underway to confirm the suitability of this option. If a vibratory hammer is chosen as the preferred boulder mitigation method, CWA will use the Cape Holland Super Triple Kong vibratory hammer system. The Super Triple Kong is comprised of three APE 600 vibratory driver/extractors.

Clamshell extraction

Given the large diameter of the monopiles, it may be possible to extract the boulder from inside the monopile with a clamshell dredge. This is potentially the fastest method, but its effectiveness depends on site-specific conditions.

Drilling

A drill that fits closely inside the monopile could be lowered to the soil plug present at approximately the seabed elevation. As the drill is rotated and advanced to the boulder, a reverse circulation (airlift) process will be used to remove the cuttings in a controlled manner through the center drill pipe. Driven by the water pressure and the rapid expansion of the injected air, an air-water mixture will quickly flow upwards in the drill pipe, pulling the drill cuttings along with the flow. The cross-flow of water from the drill annulus below the full-face bit will carry drill cuttings to the center pipe and subsequently to the surface for disposal by appropriate means. It may be necessary to deploy under-reaming bits to clear the boulder from below the pile tip, and once the obstruction has been passed, the drill will be retracted and the monopile will be advanced again by a hydraulic or vibratory hammer.

Table 1: Sound source levels for equipment to be used during Cape Wind construction operations (provided by BOEM)

Noise Source	Peak (1m)	Radius of isopleth: 206 dB re 1 µPa PEAK (m)	Radius of isopleth: 187 dB 1µPa^{2}s cSEL (m)	Radius of isopleth: 150 dB re 1uPA RMS (m)
Unabated Impact Hammer	241 dB	215	20,702	464,159
Impact Hammers with single bubble curtain (20 log r transmission loss)	233-227 dB	22	795	2,512
Vibratory Hammer	220 dB	<10m	--	<750m
Clamshell Dredge	163 dB	--	--	<50m
Drill	127 dB	--	--	--

Scour Protection

BOEM has authorized the use of rock armor at all 130 turbine foundations. The monopiles will be driven through a rock filter layer before installing the rock armor. The rock filter layer will reduce the amount of sediment that would otherwise be re-suspended in the water column as a result of the pile driving.

Prior to either filter or armor stone placement, a multi-beam survey will be performed to create a baseline for quality control of layer thickness/position and for As-Built documentation. Real time surveying of the rock placing work will be performed utilizing multi-beam sonar equipment during placing operations as a quality control measure to ensure the rock is placed in the correct location and thickness. Once the quality control surveys have shown the scour design parameters have been met, a final survey of both the filter and armor layers will be performed to be incorporated as the As-Built documentation.

Other Changes

Other changes to the COP include the change of the connector transitioning the cables from the seabed into the foundation termination point, from a "J-tube" design, to one utilizing a Tekmar cable protection system. The revised COP also incorporates the superseding provisions of the interim Marking and Lighting Changes issued by the FAA on May 25, 2014, and further provides that the Project will at all times conform to the FAA requirements that are in effect. These revisions will have no effect to Atlantic sturgeon because they involve changes to the project above the water where these species do not occur and effects from them do not extend into the marine environment. Therefore, these revisions are not further assessed in this document.

Atlantic Sturgeon in the Action Area

The marine range of all five DPSs extends from Canada through Florida and includes the action area. Atlantic sturgeon spawn in their natal river and remain in the river until approximately age two and at lengths of approximately 76-92 cm (30-36 inches; ASSRT 2007). After emigration from the natal estuary, subadult and adult Atlantic sturgeon forage within the marine environment, typically in waters less than 50 m in depth, using coastal bays, sounds, and ocean waters (ASSRT 2007). The nearest known spawning rivers to the action area are the Kennebec River (Maine) and the Hudson River (New York). Because of the distance from the nearest known spawning grounds and the salinity of the action area, no eggs, larvae or juvenile Atlantic sturgeon occur in the action area. Only subadult or adult Atlantic sturgeon could be present in the action area.

No part of the action area is a known aggregation, foraging or overwintering area for Atlantic sturgeon. Atlantic sturgeon could be moving through the action area while traveling between spawning, overwintering and foraging areas. There are very few recorded instances of Atlantic sturgeon in the action area. While there have been no targeted studies of Atlantic sturgeon in the action area, there are several longterm fisheries surveys that occur in the general vicinity. The University of Rhode Island's Graduate School of Oceanography Fish Trawl Survey operates in Narragansett Bay and has been ongoing since 1959. A single 30-minute tow is taken at each of two sites (Fox Island and Whale Rock) once per week, year round. In over 5,700 tows, only two Atlantic sturgeon have ever been captured, one in 1963 and one in 1965 (USFWS 2013). The State of Rhode Island also carries out a seasonal fishery assessment in Rhode Island and Block Island Sound with a bottom trawl. Over 3,000 tows have been carried out since 1997 and only one Atlantic sturgeon has been captured (see NMFS 2013 and 2014). The Massachusetts coastal bottom trawl survey has occurred annually in May and September since 1978 and includes sampling sites in Nantucket Sound. There have been no captures of Atlantic sturgeon in Nantucket Sound (NMFS 2013). We also reviewed Massachusetts Department of Marine Fisheries catch data and NMFS landings data for Nantucket Sound going back to 1990. While landing of Atlantic sturgeon was prohibited by the Atlantic States Marine Fisheries Commission in their 1998 moratorium and subsequently by NMFS in federal waters, there was no reported capture or landing of Atlantic sturgeon between 1990 and 1999 (MMS 2009). We have also reviewed sturgeon capture records recorded in the Northeast Fisheries Observer Program and the At Sea Monitoring program (1989-2013). There are nine recorded captures of Atlantic sturgeon in Statistical Area 538 (total records in database are 2,562) which overlaps with the majority of the action area (although it is larger than the action area) and includes all of Nantucket Sound (NMFS unpublished data). Two of the nine captures were within Nantucket Sound; the other seven captures were 5-7 miles west of Cuttyhunk, MA in Rhode Island Sound, an area that may be transited by project vessels.

Based on the best available information summarized above, if any Atlantic sturgeon are present in the action area during the construction, operation, and decommissioning of the Cape Wind project, we would expect very few of them to be there. As noted above, no part of the action area is a known foraging, overwintering area or high use area for Atlantic sturgeon, so any fish in these areas are likely to be occasional transients. Because we do not expect overwintering sturgeon in the action area, we would expect sturgeon to transit through part of the action area only between April and November, if at all.

Effects of the Action

Background Information on Noise and Sturgeon

Sturgeon rely primarily on particle motion to detect sounds (Lovell *et al.* 2005). While there are no data both in terms of hearing sensitivity and structure of the auditory system for Atlantic sturgeon, there are data for the closely related lake sturgeon (Lovell *et al.* 2005; Meyer *et al.* 2010), which for the purpose of considering acoustic impacts can be considered as a surrogate for Atlantic sturgeon. The available data suggest that lake sturgeon can hear sounds from below 100 Hz to 800 Hz (Lovell *et al.* 2005; Meyer *et al.* 2010). However, since these two studies examined responses of the ear and did not examine whether fish would behaviorally respond to sounds detected by the ear, it is hard to determine thresholds for hearing (that is, the lowest sound levels that an animal can hear at a particular frequency) using information from these studies. The best available information indicates that Atlantic sturgeon are not capable of hearing noise in frequencies above 1000 Hz (1 kHz) (Popper 2005). Sturgeon are categorized as hearing "generalists" or "non-specialists" (Popper 2005). These species do not have specializations to enhance their hearing capabilities. One such specialization is coupling between the swim bladder and the inner ear. Sturgeon do not have this coupling, which makes these species less sensitive to sound that hearing specialists. Low-frequency impulsive energies, including pile driving, can affect fish with swim bladders by causing vibrations of the swim bladder sufficient to cause damage to tissues and organs as well as to the swim bladder (Halvorsen *et al.* 2012). Sturgeon have a physostomous (open) swim bladder meaning there is a connection between the swim bladder and the gut (Halvorsen *et al.* 2012). Fish with phsyostomous swim bladders, including Atlantic sturgeon, are thought to be able to expel air with the result being dimininished tension on the swim bladder and a reduction in damaging effects during exposure to impulsive sounds. Fish with physotomous swim bladders are expected to be less susceptible to injury from exposure to impulsive sounds, such as pile driving, than fish with physoclistous swim bladders (Halvorsen *et al.* 2012).

If a noise is within a fish's hearing range and is loud enough to be detected, effects can range from mortality to a minor change in behavior (e.g., startle), with the severity of effects increasing with the loudness and duration of the noise (Hastings and Popper 2005). The actual nature of effects, and the distance from the source at which they could be experienced will vary and depend on a large number of factors, such as fish hearing sensitivity, source level, how the sounds propagate away from the source and the resultant sound level at the fish, whether the fish stays in the vicinity of the source, the motivation level of the fish, etc.

Criteria for Assessing the Potential for Physiological Effects to Sturgeon

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, USFWS, FHWA, and the California, Washington and Oregon DOTs, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a Memorandum of Agreement documenting criteria for assessing physiological effects of pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted, that these are onset of physiological effects (Stadler and Woodbury 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species, including listed green sturgeon, which are biologically similar to Atlantic sturgeon and for these purposes can be considered a surrogate. The interim criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μPa) (206 dB_{Peak}).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1μPa^2-s) for fishes above 2 grams (0.07 ounces) (187 dBcSEL).
- cSEL: 183 dB re 1μPa^2-s for fishes below 2 grams (0.07 ounces) (183 dBcSEL).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to sturgeon from exposure to impulsive noise such as pile driving, are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer the fish is to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

Since the FHWG criteria were published, two papers relevant to assessing the effects of pile driving noise on fish have been published. Halvorsen *et al.* (2011) documented effects of pile driving sounds (recorded by actual pile driving operations) under simulated free-field acoustic conditions where fish could be exposed to signals that were precisely controlled in terms of number of strikes, strike intensity, and other parameters. The study used Chinook salmon and determined that onset of physiological effects that have the potential of reduced fitness, and thus a potential effect on survival, started at above 210 dB re 1μPa^2-s cSEL. Smaller injuries, such as ruptured capillaries near the fins, which the authors noted were not expected to impact fitness, occurred at lower noise levels. Chinook salmon are hearing generalists with a physostomous swim bladder. Results from Halvorsen *et al.*, (2012a) suggest that the overall response to noise between chinook salmon and lake sturgeon is similar.

Halvorsen *et al.* (2012b) exposed lake sturgeon to pile driving noise in a laboratory setting. Lake sutrgeon were exposed to a series of trials beginning with a cSEL of 216 dB re 1uPa2-s (derived from 960 pile strikes and 186 dB re 1uPa2s ssSEL). Following testing, fish were euthanized and examined for external and internal signs of barotrauma. None of the lake sturgeon died as a result of noise exposure. Lake sturgeon exhibited no external injuries in any of the treatments but internal examination revealed injuries consisting of haematomas on the swim bladder, kidney and intenstines (characterized by the authors as "moderate" injuries) and partially deflated swim bladders (characterized by the authors as "minor" injuries). The author concludes that an appropriate cSEL criteria for injury is 207 dB re 1uPa2s.

It is important to note that both Halvorsen papers (2012a, 2012b) used a response weighted index (RWI) to categorize injuries as mild, moderate or mortal. Mild injuries (RWI 1) were determined by the authors to be non-life threatening. The authors made their recommendations for noise exposure thresholds at the RWI 2 level and used the mean RWI level for different exposures. Because we consider even mild injuries to be physiological effects and we are concerned about the potential starting point for physiological effects and not the mean, for the purposes of this consultation we will use the FHWG critieria to assess the potential physiological effects of noise on Atlantic sturgeon and not the criteria recommended by Halvorson *et al.* (2012a, 2012b). Therefore, we will consider the potential for physiological effects upon exposure to impulsive noise of 206 dB_{Peak} and 187 dBcSEL. Use of the 183 dBcSEL threshold is not appropriate for this consultation because all Atlantic sturgeon in the action area will be larger than 2 grams. As explained here, physiological effects from noise exposure can range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality, or result in death.

Available Information for Assessing Behavioral Effects on Sturgeon

To date, neither NMFS nor the FHWG have published criteria for underwater noise levels resulting in behavioral responses. However, in practice, we rely on a level of 150 dB re 1uPa RMS as a conservative indicator as to when a behavioral response can be expected in fish exposed to impulsive noise such as pile driving. This level is based on the available literature where fish behavior has been observed (see for example Fewtrell 2003 and Mueller-Blenkle *et al.* 2010). Because there are no published studies establishing the noise levels at which sturgeon respond behaviorally to noise, these studies of fish which are likely more sensitive to noise than Atlantic sturgeon are a reasonable conservative indicator of when sturgeon can be expected to respond behaviorally to noise.

Fewtrell (2003) exposed caged fish to air gun arrays. Fewtrell (2003) reported altered behavioral responses (alarm responses, faster swimming speeds) for fish exposed to noise of 158-163 dB re 1uPa. Consistent startle responses were observed at noise levels of 167-181 dB re 1uPa (in striped trumpeters). Alarm responses became more frequent at noise levels above 170 dB re 1uPa. Fewtrell reports that avoidance behavior is expected at noise levels lower than that required to produce a startle response.

Mueller-Blenkle *et al.* (2010) played back pile-driving noise to code and sole held in two large net pens. Movements of fish were tracked and received sound pressure levels were measured. The authors noted a significant movement response to the pile-driving stimulus in both species at received SPL of 144-156 dB re 1uPa peak (cod) and 140-161 dB re 1uPa peak (sole). Indications of directional movements away from the sound source were noted in both species. We are aware of only one study that has attempted to assess the behavioral responses of sturgeon to underwater noise.

A monitoring plan is currently being implemented at the Tappan Zee Bridge replacement project (Hudson River, New York) using acoustic telemetry receivers to examine the behavior of acoustically tagged sturgeon. During the installation of test piles, the movements of tagged Atlantic sturgeon were monitored with a series of acoustic receivers. Tagged Atlantic sturgeon spent significantly less time in the detection area (an area that encompassed the 206 dB re 1uPa peak, 187 dB re 1uPa 2s cSEL and 150 dB re 1uPa RMS SPL isopleths), during active impact pile driving compared to that time period just prior to the work window. Results of this study indicate that sturgeon are likely to avoid areas with potentially injurious levels of noise (AKRF and Popper (2012a, 2012b). However, due to limitations of the study design, it is not possible to establish the threshold noise level that results in behavioral modification or avoidance of Atlantic sturgeon. Monitoring is ongoing as the bridge project progresses. To date, hundreds of tagged sturgeon have been documented in the project area; however, no sturgeon have been injured or killed as a result of exposure to pile driving noise.

For the purposes of this analysis, we will use 150 dB re 1 μPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects, provided the operational frequency of the source falls within the hearing range of the species of concern. That is not to say that exposure to noise levels of 150 dB re 1 μPa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of "take" (i.e., harm or harassment) but that there is a potential, upon exposure to noise at this level, to experience some behavioral response. We expect that behavioral responses could range from a temporary startle to avoidance of the area with disturbing levels of sound. The effect of any anticipated response on individuals will be considered in the effects analysis below.

Pile Driving

Sound levels associated with the driving of the monopiles that will support the wind turbines have been modeled and results are presented in Table 1. Modeling indicates that the source level of the noise (dB re 1uPa at 1 meter) with the required single bubble curtain will be 241 dB re 1uPa peak with a spectral energy of 1Hz to 20 kHz for the impact hammer and 220 dB re 1uPa peak for the vibratory hammer. A vibratory hammer may be used for boulder mitigation. Only one pile will be installed at a time, with each pile needing 4-6 hours of pile driving at a rate of 2-36 strikes per minute. Table 1 considers noise produced during the installation of the 5.1-5.5 m diameter monopiles that will support the 130 WTGs. Modeling has not been carried out for installation of the 8 42" piles that will support the ESPs. However, because underwater noise is directly related to pile diameter (i.e., larger diameter steel piles will be louder than smaller diameter steel piles when installed in the same area with the same equipment; Illingworth and Rodkin 2007), these results represent an extreme worst case for the 8 42" piles, which are about 20% the diameter of the monopiles.

As noted above, we expect potential injury to Atlantic sturgeon upon exposure to pile driving noises greater than 206 dB re 1μPa peak or 187 dB re 1uPa cSEL. Modeling results indicate that the 206 dB re 1uPa peak isopleth will have a radius no larger than 22 meters. Therefore, to experience noise loud enough to cause injury with just a single exposure (i.e., one strike of the hammer), a sturgeon would need to be within 22 meters of the pile being driven. There are several factors that make exposure to injurious levels of noise extremely unlikely to occur. First, if Atlantic sturgeon are present in the action area, they would be there only in very low numbers, making the likelihood of their occurrence in any particular area low at best. Further, even if a sturgeon was very close to the pile installation site, all pile driving operations will be initiated with a "soft" start or a system of "warning" strikes that are designed to create enough noise to cause fish to leave the area prior to full energy pile driving; that is, the impact hammer will be operated at 40 percent of its total energy, which will result in the production of underwater noise levels at or above 150 dB_{RMS} (within seconds of the initiation of pile driving operations), but below 206 dB_{Peak}. That is, the noise levels will be below those likely to result in injury (206 dB peak) but above those likely to result in a sturgeon swimming away from the noise source (150 dB re 1uPa RMS). At this energy level, warning strikes will consist of a set of 3 strikes on the pile, followed by a one minute waiting period; this will be performed two subsequent times. As described above, sturgeon are expected to respond behaviorally, via avoidance, upon exposure to bothersome levels of noise (greater than 150 dB re 1uPa RMS; see below for further assessment of behavioral effects). As a result, we expect any sturgeon close to the piles when pile driving begins, will detect the warning strikes and begin to move away from the noise source. This expectation is consistent with the results reported by AKRF and Popper (2012) during pile installation for the Tappan Zee Bridge. Because the soft-start will take 3-5 minutes, we expect sturgeon to move more than 22 meters from the pile and therefore, never be exposed to a single strike peak noise of 206 dB re 1uPa.

In addition to the "peak" exposure criteria, which relates to the energy received from a single pile strike, the potential for injury exists for multiple exposures to lesser noise. That is, even if an individual fish is far enough from the source to not be injured during a single pile strike, the potential exists for the fish to be exposed to enough smaller-impact strikes to result in physiological impacts. The cSEL criterion is used to measure such cumulative impacts. The cSEL is not an instantaneous maximum noise level, but is a measure of the accumulated energy over a specific period of time (e.g., the period of time it takes to install a specific structure, such as a pile). For the proposed action, it will take 4-6 hours to install each pile, with only one pile being driven per day. The cSEL is calculated by incorporating both the noise level associated with a single strike of the pile as well as the total number of pile strikes. Because the cSEL accounts for all of the strikes necessary to install a pile, we must consider if it is reasonably likely that a sturgeon will be exposed not to a single pile strike but the number of pile strikes used for the calculation. In this case, because it will take 4-6 hours of driving to install each pile, a sturgeon would only be exposed to noise at 187 dB re 1uPa 2s cSEL if it remained within 795m of the pile being installed for the entire duration of pile driving (modeled at 5 hours). It is extremely unlikely that a sturgeon would remain within this distance of the pile being driven for the entire pile driving period. From the initiation to the completion of pile driving, disturbing levels of underwater noise will be produced within seconds of each strike of the pile and thus, well before any energy is accumulated to a level in which injury may occur. As described above, a soft start will be undertaken prior to the initiation of pile driving at full energy, and thus, will result in underwater noise levels (150 dB_{RMS}) that will result in the movement of Atlantic sturgeon away from the pile being installed. As each strike of the pile intensifies, the extent at which the 150 dB_{RMS} will be experienced will also increase; that is at full energy, underwater noise levels of 150 dB_{RMS} will be experienced at a distance of 2.5 km from the source. Thus, sturgeon that left the area during the initiation of pile driving will continue to divert their movements away from the sound source as pile driving operations continue and the area of behaviorally disturbing levels of noise increases. As a result, any sturgeon that may have been present at the onset of pile driving operations is not expected to be found within 2.5 km of the pile, and thus, are not expected to remain within the area long enough to accumulate injurious pressure levels.

As explained above, in order to be exposed to pile driving noise of 187 dB re 1uPa 2s cSEL, a sturgeon would need to remain within 795 meters of the pile for the entire duration of pile driving. Once a sturgeon is further than 795 meters from the pile there is no potential for exposure to injurious levels of sound. We expect sturgeon to start swimming away from the pile as soon as pile driving begins. We have considered whether a sturgeon is likely to be able to swim far enough away from the pile being installed in time to avoid exposure to the full duration of pile installation. In order to avoid being exposed to injurious levels of noise, a sturgeon adjacent to a pile at the onset of installation, it would need to swim 795 m before the end of a 5 hour pile driving time, requiring a swim speed of approximately 0.159 km/hour (4.4 cm/s or 0.14 ft/s).

Swimming speeds of fish are generally classified as sustained, prolonged, or burst. Sustained speeds are low and those which the fish can maintain for long periods (i.e., >200 min). They depend on aerobic metabolism, do not result in muscular fatigue, and are used in foraging and other routine activities. Prolonged speeds are moderate, of intermediate duration (i.e., 0.5–200 min), and use aerobic and anaerobic metabolism. Burst speeds are the highest attainable speeds, but can only be maintained for short periods (i.e., <0.5 min) due to accumulation of anaerobic metabolites and muscular fatigue (Peake 2004 in LeBreton *et al.* 2004). Higher prolonged and burst speeds are used in prey capture, short-term movements in fast current, and predator avoidance and, consequently, can be used to characterize 'escape' speeds. We would expect sturgeon swimming away from a loud noise (such as a pile being installed with an impact hammer) to start out at "burst" or "escape" speed and then slow down to "prolonged" or "sustained" speed when its burst speed duration had been exceeded. Maximum swim speed for sturgeon can be described as a linear function of fish length; given that, larger fish are expected to be capable of swimming faster than smaller fish (Peake 2004). Any sturgeon in the action area are expected to be at least 76 cm (the expected minimum size of Atlantic sturgeon migrating outside of their natal estuary; ASSRT 2007). Given the morphological similarities between all sturgeon species, it is reasonable to use other sturgeon species as a surrogate for establishing swim speed of Atlantic sturgeon.

A study examining daily non-migratory movements of subadult and adult green sturgeon (101-153 cm TL) in San Francisco Bay (Kelly and Klimley 2011) reports an average swimming speed of 0.5-0.6 meters/second (1.6-2 fps) with a maximum recorded speed of 2.1 meters/second (7 fps). Reported burst (also called critical or maximum) swim speeds of subadult and adult shovelnose, lake, and green sturgeon range from 60-116 cm/s (1.9-3.8 fps) (Cheong *et al.* 2006). Sustained swim speeds of adult lake sturgeon were reported as 83.7 cm/s (2.74 fps) (Cheong *et al.* 2006).

Hoover *et al.* (2011) demonstrated the swimming performance of juvenile lake sturgeon and pallid sturgeon (12 – 17.3 cm FL) in laboratory evaluations. The authors compared swimming behaviors and abilities in water velocities ranging from 10 to 90 cm/second (0.33-3.0 fps). They report burst swim speeds of 40-70cm/s (1.3-2.3 fps), prolonged swimming at 15-70cm/s (0.5-1.5 fps) and sustained swimming at speeds of 10-45 cm/s (0.3-1.5 fps). Boysen and Hoover (2009) assessed the probability of entrainment of juvenile white sturgeon by evaluating swimming performance of young of the year fish (8-10 cm TL). The authors report escape speeds of 40-45 cm/s. Kieffer *et al.* (2009) reports maximum swim speeds of juvenile shortnose sturgeon (14-

18cm) as 3.4 cm/s (or 2.18 body lengths/second). Clarke (2011) reports on swim tunnel performance tests conducted on juvenile and subadult Atlantic, white and lake sturgeon. He concludes that burst swim speed is approximately 65 cm/s (2.1 fps) and prolonged swim speed is 45 cm/s (1.5 fps). We expect the Atlantic sturgeon in the action area to have greater swim speeds than the juveniles studied due to their significantly larger size.

Assuming that the sturgeon in the action area have a swimming ability at least equal to those subadults reported in studies summarized above, we expect all Atlantic sturgeon in the action area to have a prolonged swim speed of at least 1.5 fps (45 cm/s) and an escape or burst speed of at least 2.1 fps (64 cm/s). Sturgeon are expected to be able sustain their prolonged swim speed for up to 200 minutes without muscle fatigue and their sustained swim speed for periods longer than 200 minutes. To move away from a pile being installed in sufficient time to avoid accumulating enough energy to result in injury, a sturgeon would need to be swimming at 0.14 fps for a maximum period of 5 hours. This is far less than the minimum prolonged swim speed reported for subadult sturgeon (1.5 fps). At a prolonged swim speed of 1.5 fps, a sturgeon would be able to swim outside the area where potentially injurious levels of noise could be experienced (795 m) in less than 30 minutes. Therefore, we expect all sturgeon in the action area to be able to readily swim away from the ensonified area at a normal sustained swim speed in time to avoid injury. Based on this analysis, we do not expect any Atlantic sturgeon to be exposed to noise resulting from impact pile driving that could result in physiological effects including injury or mortality.

As described above, Atlantic sturgeon are expected to react behaviorally to underwater noise levels of 150 dB_{RMS} by demonstrating avoidance behaviors. Underwater noise levels of 150dB_{RMS} will extend a maximum of 2.5 km from the pile being driven. Any sturgeon within 2.5 km of the pile being driven are expected to swim away from the noise until they are outside the area where noise is louder than 150dB RMS. Any sturgeon outside of the area where noise is louder than 150 dB RMS would avoid the area with elevated noise until the pile driving stops. As noted above, pile driving will occur for no more than 6 hours per day. Very few Atlantic sturgeon are likely to be present in the area where noise will be elevated above 150 dB RMS (i.e., within Nantucket Sound).

The effect of avoiding this area for up to a 6-hour period is expected to be insignificant given that if the area is used at all it would only be used for occasional transient movements between other areas. Avoiding the ensonified area would not result in any negative impacts to any Atlantic sturgeon. Sturgeon that make evasive movements to avoid the area with disturbing levels of noise may experience increased energy expenditure and a delay of resting and foraging. However, due to the temporary nature of the disturbance (i.e., 6 hours a day), and the transient nature of any individuals in the action area, an individual Atlantic sturgeon would only experience this disturbance once. Because a sturgeon will be able to "escape" from the noisy area at normal, sustained or prolonged swim speeds, any increased metabolic cost is expected to be insignificant and will not cause any physiological stress to the fish. Based on this analysis, all effects to Atlantic sturgeon from avoidance behavior will be insignificant and/or discountable.

Clamshell Dredge
Peak noise of the clamshell dredge will be 163 dB re 1uPa; it is below the levels that could result in injury to Atlantic sturgeon. Noise associated with the clamshell dredge will attenuate to below 150 dB within 50 meters of the pile where the dredge is being used. It is extremely unlikely that an Atlantic sturgeon would be within 50 meters of any pile where the clamshell dredge is used. However, even if a sturgeon was present, it would be expected to leave the area where noise is greater than 150 dB. Swimming at a normal swim speed of 1.5 fps, a sturgeon would be able to leave the noisy area in less than 2 minutes. Avoiding the ensonified area would not result in any negative impacts to any Atlantic sturgeon. Sturgeon that make evasive movements to avoid the area with disturbing levels of noise may experience increased energy expenditure and a delay of resting and foraging. However, due to the extremely limited time it would take to swim away from the increased noise (less than 2 minutes) and the very short distance the fish would need to travel (less than 50 meters), any increased metabolic cost is expected to be insignificant and will not cause any measurable physiological stress to the fish. Based on this analysis, any effects to Atlantic sturgeon from avoidance behavior will be insignificant and/or discountable. Because the clamshell dredge will only be operated within the monopile, no Atlantic sturgeon will be exposed to any other effects of use of the clamshell dredge.

Drilling
BOEM reports expected noise levels during drilling of 127 dB re 1uPa (see Table 1). Noise levels that could result in injury (i.e., greater than 206 dB re 1uPa peak or 187 dB re 1uPa2s cSEL) or may elicit a behavioral response (i.e., greater than 150 dB re 1uPa RMS) will not be generated during drilling. Therefore, any Atlantic sturgeon exposed to underwater noise associated with drilling would not be affected. Because the drill will only be operated within the monopile, no Atlantic sturgeon will be exposed to any other effects of use of the drill.

Multibeam surveys
A multi-channel multi-beam depth sounder will be used to make inspections associated with scour protection. The equipment operates at frequencies between 200-400 kHz (ESS 2012). The multi-beam depth sounder operates at a frequency well above the hearing abilities of sturgeon (less than 1000 Hz; Lovell *et al.* 2005; Meyer *et al.* 2010). Therefore, any Atlantic sturgeon exposed to underwater noise associated with drilling would not be affected.

Noise of Project Vessels
Noise levels that may elicit a behavioral response (i.e., greater than 150 dB re 1uPa RMS) will only be experienced within several meters of the project related vessels. Given the rarity of Atlantic sturgeon in the action area, we do not expect Atlantic sturgeon to be that close to any project vessel; therefore, we do not anticipate any behavioral disturbance from noise associated with the operations of the project vessels.

Operation of WTGs
The noise producing components of the WTG are at the nacelle, hundreds of feet above the water surface. Underwater noise is expected to be only slightly elevated above ambient noise levels (109.1 dB and 107.2 dB, respectively) and is well below noise levels that may cause a behavioral response. Because of this, there will be no effects to any Atlantic sturgeon.

Interactions with the Cable Laying Operations

Jet plows move along the benthos at slow speeds (i.e., < 1 knot). As sturgeon are highly mobile, any sturgeon that may be present at or near the benthos will be able to move out of the way of the device, thereby avoiding an interaction. Although any sturgeon present in the vicinity of the jet plow may be displaced, displacement would be temporary (i.e., for the duration of the jet pass; no more than a few minutes) and will only result in a temporary shift in swimming direction away from the area affected by the jet plow for up to several minutes. This displacement will not affect the ability of the individual to complete any essential life functions (i.e., opportunistic foraging, resting, migrating) that may take place along the cable route as any animals that may have moved from the affected area will be able to continue normal life functions in other nearby unaffected areas and will also be able to resume these behaviors once the jet plow has passed. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Based on this information, we believe that it is extremely unlikely that any sturgeon will interact with cable laying and jetting equipment and thus, believe that any effects of the use of this equipment are discountable.

Electromagnetic Field

The inner-array and submarine cable is a dielectric AC cable, consisting of a core of 3-phase conductors encased by grounded metallic (i.e., lead) shielding that effectively blocks any electric field generated by the operating cabling system.

Research on EMF also indicates that although high sensitivity has been demonstrated by certain species (especially sharks) for weak electric fields, this sensitivity is limited to steady and slowly-varying fields (Cape Wind Tech Report; ICNIRP 2010; Adai 1994; Valberg *et al.* 1997 in MMS 2009; Normandeau *et al.* 2011). The proposed action produces 60-Hz time-varying fields and no steady or slowly-varying fields. Likewise, evidence exists for marine organisms utilizing the geomagnetic field for orientation, but again, these responses are limited to steady and slowly-varying fields. 60-Hz alternating power-line EMF fields, such as those generated by the proposed action, have not been reported to disrupt marine organism behavior, orientation, or migration. Based on the body of scientific evidence, there are no anticipated adverse impacts from the undersea power transmission cables or other components of the proposed action on the behavior, orientation, or navigation of marine organisms, including Atlantic sturgeon, or their prey species. Based on this and the best available information, any effects of the magnetic fields associated with the operation of the cable systems are insignificant and discountable.

The burial depth of the cables also minimizes potential thermal impacts from operation of the cable system. No thermal impacts to Atlantic sturgeon are anticipated.

Project Related Vessels

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes may be related to size and speed of the vessels, navigational clearance (*i.e.*, depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of Atlantic sturgeon in the area (e.g., foraging, migrating, etc.) (Brown and Murphy 2010). It is important to note that while vessel strikes may occur in other rivers, they have been identified as a significant concern only in the upper Delaware and James rivers and current thinking suggests that there may be unique geographic features in these areas (e.g., potentially narrow migration corridors combined with shallow/narrow river channels) that increase the risk of interactions between vessels and Atlantic sturgeon. There are no documented vessel strikes in the ocean or in the action area. The risk of vessel strikes between Atlantic sturgeon and vessels operating in the action area is likely to be very low given that the vessels are operating in an open water environment and there are no restrictions forcing Atlantic sturgeon into close proximity with the vessel as may be present in some rivers. We also expect Atlantic sturgeon in the action area, if any, to be at or near the bottom. Given the depths in the action area and the draft of project vessels, interactions between project vessels and fish at or near the bottom are extremely unlikely. Based on these factors, an Atlantic sturgeon strike due to the increase in vessel traffic is discountable.

Destruction of Prey Resources/Loss of Foraging Habitat
Activities that disturb the sea floor will also affect benthic communities, and can cause effects to Atlantic sturgeon by reducing the numbers or altering the composition of the species upon which Atlantic sturgeon prey. Activities that may affect the sea floor and result in the loss of foraging resources for listed species include:

- Cable installation;
- WTG and ESP installation;
- Scour protection (scour mats and rock armoring).

Loss of Benthic Resources/Habitat
The proposed action will result in both the temporary disturbance and permanent loss of benthic habitat. Effects to benthic resources and habitat will be restricted to the area within the project footprint and along the cable route where sediment disturbing activities will occur. Atlantic sturgeon in the marine environment feed on benthic invertebrates and small fish, such as sand lance. However, given the use of the action area by only a small number of transient individuals, any foraging is expected to be very limited if it occurs at all.

The installation of the submarine transmission and inner-array cables will result in temporary impacts to approximately 866 acres (less than 6% of the action area). This accounts for the 4-6 foot wide trench that will be jetted along the 12.5 mile submarine transmission cable and the 70 miles of inner-array cables. The jetting process will affect benthic resources and habitat in two ways: entrainment of microorganisms and displacement or burial of other benthic resources. Some mobile organisms (such as fish) are expected to move away from the disturbance; however, in general, we anticipate a temporary loss of benthic invertebrates along the cable route. Impacts associated with cable installation, barge positioning, anchoring, anchor line sweep, and the pontoon on the jet plow device would be temporary and localized. Impacts from anchor line sweep would primarily affect the sediments to a depth of between 3 and 6 inches. Anchoring locations would have disturbances to the sediment to a depth of 4 to 6 feet at each anchor deployment, leaving a temporary irregularity to the seafloor with localized mortality of infauna. Jet plow embedment would directly disturb sediments to a depth of approximately 8 feet.

Modeling was presented by BOEM in the DEIS which estimated seabed scar recovery from jet plow cable burial operations. Using the assumption that 3 percent of the sediments in the jetted cross section could be injected back into the water column and that the coarse sediment column is returned to the trench, it was estimated that the dimensions of the scar left along the cable routes would be 6 feet wide and from 0.75 to 1.7 feet deep. BOEM also estimated approximate recovery times for the trench scars. Based on bedload transport rates for Horseshoe Shoal and throughout Nantucket Sound, recovery rates for jetting scars along the cable route are estimated to be between 0.2 and 38 days. Recovery of jetting scars on Horsehoe Shoal is anticipated to occur within a few days. It is likely that seabed scars from cable burial in Lewis Bay, MA (where the cable will make landfall) would last months or until a major storm occurs.

Egg and larval stages of demersal species would experience some mortality due to burial. The temporary displacement of benthic habitats is also likely to result in the mortality and/or dispersal of other benthic organism in the footprint of the construction activities. As the jetting and cable laying occurs very slowly, most mobile organisms (i.e., crabs, finfish) are likely to be able to avoid the area where the jet plow is operating. The cable route has been designed to avoid eel grass beds in Lewis Bay. There are very limited areas of submerged aquatic vegetation (SAV), mostly macroalgae as opposed to sea grass that will be affected by construction on Horseshoe Shoal.

The alteration of benthic habitat and the loss of benthic resources during construction could reduce the amount of potential forage for Atlantic sturgeon, albeit by an extremely small amount. However, most mobile organisms, including most Atlantic sturgeon prey items, are likely to be able to avoid the jetting. Recolonization of temporarily disturbed areas is expected to be rapid, with colonization by mobile organisms beginning within days and complete recolonization occurring within 3-12 months. As cable laying will occur over several months and recovery of benthic communities will take another several months, foraging opportunities along the cable route may be reduced for one to two years. However, as only a small percentage of Nantucket Sound will be affected, any impacts to Atlantic sturgeon foraging opportunistically in the area will be limited to movements to areas where benthic invertebrates were not disturbed adjacent to the jet plow path. Given the narrow corridor to be affected, these movements would be small and localized.

The installation of the WTG monopiles and the ESP will result in the permanent loss of 0.67 acres of benthic habitat (less than 0.0042% of the project area). Although these impacts would result in permanent loss of 0.67 acres of bottom that may support benthic invertebrates, the areas impacted are not contiguous and impacts to any Atlantic sturgeon foraging in the area will be limited to movements to areas not impacted. These limited movements to nearby areas will not have a detectable effect on Atlantic sturgeon.

Habitat Shift

The presence of 130 monopile foundations, 8 ESP piles and their associated scour control mats in Nantucket Sound has the potential to shift the area immediately surrounding each monopile from soft sediment, open water habitat to a structure-oriented system. This may create localized changes, namely the establishment of "fouling communities" within the area and an increased availability of shelter among the monopiles. The WTG monopile foundations will represent a source of new substrate with vertical orientation in an area that has a limited amount of such habitat, and as such may attract finfish and benthic organisms. Although the monopile foundations would create additional attachment sites for benthic organisms that require fixed (non-sand) substrates and additional structure that may attract certain finfish species, the additional amount of surface area being introduced (approximately 1,200 square feet (111 square meters) per tower, assuming an average water depth of 30 feet (9.1m) below mean high water (MHW)) would be a minor addition to the hard substrate that is already present. Due to the small amount of additional surface area in relation to the total area of the proposed action and Nantucket Sound and the spacing between WTGs (0.34 to 0.54 nautical miles (0.63 to 1.0 km) apart), the new additional structure is not expected to alter the species composition in the action area. While the increase in structure and localized alteration of species distribution in the action area around the WTG monopiles may affect the localized movements of Atlantic sturgeon in the action area and provide additional foraging opportunities in the action area for these species, any effects will be beneficial or insignificant.

Water Quality Degradation and Increased Marine Debris

Increased Turbidity and Exposure to Contaminated Sediments

Increased turbidity and resuspension of sediments can be expected from the following activities:

- Cable installation;
- WTG and ESP pile installation; and,
- Vessel anchoring.

Of these activities, cable installation, including jetting and backfill, is expected to generate the most turbidity and disturbance of bottom sediments. Simulations of sediment transport and deposition from jet plow embedment of the submarine cable system and inner array cables were performed and reported in BOEM's BA and DEIS and explained in the 2010 Opinion. The model results demonstrate that concentrations of suspended sediment in the water column resulting from the jet plow embedment operations are largely below 50mg/L in Nantucket Sound. The modeling results indicate that the suspended sediment concentration levels are short lived due to the tides flushing the plume away from the jetting equipment and the sediments rapidly settling out of the water column. For example, the duration of time when suspended sediment levels will be greater than 10mg/L above background levels is less than 3 hours after the jet plow has passed a given point along the route. In places along and immediately adjacent to the cable route, suspended sediment concentrations are predicted to remain at 100mg/L for 2-3 hours.

In Lewis Bay (where the cable will make landfall), suspended sediments are predicted to remain in suspension considerably longer than in Nantucket Sound due to weak tidal currents. Modeling demonstrates that the concentration of suspended sediment in the water column resulting from jet plow operations in Lewis Bay will be below 500mg/L. Suspended sediment concentrations in excess of 100mg/L are generally predicted to remain for less than 2 hours with the exception of some sections along the route where durations may be as long as 6 hours. Suspended sediment concentrations in excess of 10mg/L above background are generally predicted to remain for less than 24 hours after the jet plow has passed a given point, with the exception of the area near the Yarmouth landfall where concentrations in excess of 10mg/L are predicated to remain for up to 2 days after the jet plow passes as a result of very weak currents and fine bottom sediments.

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). The Normandeau 2001 report identified five species in the Kennebec River for which TSS toxicity information was available. The most sensitive species reported was the four spine stickleback which demonstrated less than 1% mortality after exposure to TSS levels of 100mg/L for 24 hours. Striped bass showed some adverse blood chemistry effects after 8 hours of exposure to TSS levels of 336mg/L. While there have been no directed studies on the effects of TSS on shortnose or Atlantic sturgeon, shortnose and Atlantic sturgeon juveniles and adults are often documented in turbid water and Dadswell *et al.* (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. Cech and Doroshov (2004) report that sturgeon generally prefer dimly lit, moderately turbid water. As such, Atlantic sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass.

The life stages of sturgeon most vulnerable to increased sediment are eggs and larvae which are subject to burial and suffocation. As noted above, no eggs and/or larvae will be present in the action area. Sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. TSS is most likely to affect subadult or adult Atlantic sturgeon if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting their benthic prey. Because any increase in suspended sediment is minor and temporary, it will not affect the movement of individual sturgeon. Even if the movements of sturgeon were affected, these changes would be small. As sturgeon are highly mobile any effect on their movements or behavior will be insignificant. Additionally, the TSS levels expected are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical; see summary of scientific literature in Burton 1993) and benthic communities (390.0 mg/L (EPA 1986)); therefore, effects to benthic resources that sturgeon may eat are extremely unlikely. Based on this information, any effects of increased suspended sediment and turbidity will be insignificant.

Contaminants

BOEM has reported that analysis of sediment core samples obtained from the area of the proposed action indicate that sediment contaminant levels were below established thresholds in reference Effect Range-Low and Effects-Range-Median marine sediment quality guidelines. Therefore, the temporary and localized disturbance of these sediments during the proposed action's construction activities are not anticipated to result in increased contaminants in lower trophic levels. Therefore, Atlantic sturgeon are not likely to experience increased bioaccumulation of chemical contaminants in their tissues from the consumption of prey items in the vicinity of the proposed action, and any effects to whales or sea turtles from the disturbance of these sediments will be discountable. Since other sources of turbidity and seafloor disturbance (i.e., pile installation and scour protection placement) will be minimal compared to that caused by cable installation, the overall effect of project construction on Atlantic sturgeon due to turbidity and exposure to contaminants is insignificant or discountable.

Increased Marine Debris
Personnel will be present onboard the barges throughout construction activities, thus presenting some potential for accidental releases of debris overboard. Discharge of debris overboard by vessel personnel will be prohibited, and violations will be subject to enforcement actions. As a result, construction activities are not expected to result in increased marine debris. Therefore, effects to Atlantic sturgeon are discountable are not anticipated. Even if some garbage does enter the water, effects to sturgeon are discountable given sturgeon feed on bottom dwelling invertebrates and small fish and are extremely unlikely to ingest pieces of garbage.

Decommissioning
At the conclusion of the life of the Cape Wind project, components would be retrieved and removed from the site. All components in the water column would be retrieved, including the ESP, WTGs, and submarine cables. At the end of the proposed action's lifespan, removal of the WTG monopile foundations and ESP piles at the time of decommissioning would result in a localized shift from a structure-oriented habitat near the WTGs and ESP to the original shoal-oriented habitat present prior to construction to the proposed action. However, as the addition of the monopiles would be a minor addition to the hard substrate that was present prior to the construction of the WTG facility, the removal of the WTGs and ESPs will not cause a great impact in the overall habitat structure. Therefore, the number of Atlantic sturgeon in the action area will not increase due solely to the presence of the monopiles (and an associated increase in colonizing benthic invertebrate prey) and hence would not be adversely affected by their removal.

These removal activities are expected to have impacts similar to those discussed above in relation to construction activities. However, all impacts would be of less magnitude than those resulting from construction activities. As such, any effects of decommissioning activities will be insignificant or discountable.

Non-routine and Accidental Events

Cable Repair
Many of the types of disturbances that would occur during cable repair activities are smaller and of shorter duration, but of similar type, to those that would occur during cable installation. A relatively short distance along the sea floor would be disturbed by the jetting process used to uncover the cable and allow it to be cut so that the cable ends could be retrieved to the surface. In addition to the temporary loss of some benthic organisms, there would be increased turbidity for a short period, and a localized increase in disturbance due to vessel activity, including noise and anchor cable placement and retrieval. As explained in the cable installation sections above, any effects of the cable laying process, and similarly, the cable repairing process, would be insignificant or discountable.

Vessel Collision with Monopile
Effects, if any, to Atlantic sturgeon from a vessel collision with a monopile would be limited to the effects of vessel or monopole parts that enter the water and of the effects of any repair activities. Given the low risk of vessel collision with a monopole and the scarcity of Atlantic sturgeon in the area, any effects are insignificant or discountable.

Oil Spill
As noted in the 2010 Opinion, oil spills could occur either as a release from the ESP storage tank or from a vessel collision with a monopile. An oil spill would be an unintended, unpredictable event. Marine animals, including sturgeon, could be negatively impacted by exposure to oil and other petroleum products. Without an estimate of the amount of oil released it is difficult to predict the likely effects on listed species. CWA is required to develop an oil spill response plan which would ensure rapid response to any spill. As the effects of a spill are likely to be localized and temporary as well as extremely unlikely to occur, Atlantic sturgeon are extremely unlikely to be exposed to oil. Any effects are therefore discountable. Additionally, should a response be required by the US EPA or the USCG, there would be an opportunity for NMFS to conduct a consultation with the lead Federal agency on the oil spill response, which would allow NMFS to consider the effects of any oil spill response on listed species in the action area in light of the specific situation at the time.

Air Emissions from Project Vessels Operating on the OCS
In the 2010 Opinion, we noted that any effects to air quality from the proposed action are likely to be insignificant. As in 2010, there is no information on the effects of air quality on listed species that may occur in the action area, including Atlantic sturgeon. However, as the emissions regulated by EPA will have insignificant effects on air quality, it is reasonable to conclude that any effects to Atlantic sturgeon from these emissions will also be insignificant.

Conclusions Regarding Atlantic Sturgeon
We have determined that any and all effects to the Atlantic sturgeon will be insignificant and/or discountable. Accordingly, we concur with your determination that the proposed action is not likely to adversely affect any DPS of Atlantic sturgeon, individually or collectively. No incidental take of Atlantic sturgeon is anticipated or exempted. Take is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." If there is any incidental take of Atlantic sturgeon, reinitiation of consultation will be required.

Loggerhead Sea Turtle
As you know, the 2010 Opinion considered the effects of the Cape Wind project on the loggerhead sea turtle as listed globally; however, on September 22, 2011, we published a final rule (76 FR 58868), replacing the global listing of the loggerhead with nine loggerhead DPSs distributed globally: (1) North Pacific Ocean DPS, (2) South Pacific Ocean DPS, (3) North Indian Ocean DPS, (4) Southeast Indo-Pacific Ocean DPS, (5) Southwest Indian Ocean DPS, (6) Northwest Atlantic Ocean DPS, (7) Northeast Atlantic Ocean DPS, (8) Mediterranean Sea DPS, and (9) South Atlantic Ocean DPS. In a November 22, 2011 memorandum, we previously

concluded that the effects analysis and jeopardy analysis included in the 2010 Opinion remains valid for the Northwest Atlantic DPS. That memo is enclosed here for your reference.

As you also know, critical habitat was designated for the Northwest Atlantic DPS of loggerhead sea turtles on July 10, 2014 (79 FR 39856). Several areas off of the U.S. Atlantic coast were designated as critical habitat; however, none of these areas extend further north than 37.84°N latitude. The Cape Wind action area does not overlap with any of the areas designated as critical habitat for the Northwest Atlantic DPS of loggerheads. Therefore, as stated in the 2010 Opinion, there is no designated critical habitat in the action area and none will be affected by the construction, operation or decommissioning of the Cape Wind project. Our conclusions are consistent with the determination regarding loggerhead critical habitat in your September 2014 assessment accompanying your letter.

We look forward to continuing to work with your office as the Cape Wind project moves forward. For further information regarding any consultation requirements, please contact Julie Crocker of my staff at (978)282-8480 or by e-mail (Julie.Crocker@noaa.gov).

Sincerely,

John K. Bullard
for Regional Administrator

Enclosure

Ec: Boelke – F/NER4
USACE
EPA
DOE

File Code: Sec 7 BOEM Cape Wind
PCTS: NER-2010-3866

Literature Cited

AKRF and A.N. Popper. 2012a. Presence of acoustic-tagged Atlantic sturgeon and potential avoidance of pile-driving activities during the Pile Installation Demonstration Project (PIDP) for the Tappan Zee Hudson River Crossing Project. September 2012. 9pp.

AKRF and A.N. Popper. 2012b. Response to DEC memo reviewing AKRF sturgeon noise-analysis for the Tappan Zee Hudson River Crossing Project. November 2012. 7pp.

Andersson, M.H., M. Gullstrom, M.E. Asplund, and M.C. Ohman. 2007. Swimming Behavior of Roach (Rutilus rutilus) and Three-spined Stickleback (Gasterosteus aculeatus) in Response to Wind Power Noise and Single-tone Frequencies. AMBIO: A Journal of the Human Environment 36: 636-638.

Atlantic Sturgeon Status Review Team (ASSRT). 2007. Status Review of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*). Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 174 pp.

Beregi A, C. Székely, L. Békési, J. Szabó, V. Molnár, and K. Molnár. 2001. Radiodiagnostic examination of the swimbladder of some fish species. Acta Veterinaria Hungarica 49: 87– 98.

Brown. J.J. and G.W. Murphy. 2010. Atlantic sturgeon vessel-strike mortalities in the Delaware Estuary. Fisheries 35(2):72-83.

Burton, W.H. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Versar, Inc. 9200 Rumsey Road, Columbia, MD 21045

California Department of Transportation (Caltrans). 2001. Pile Installation Demonstration Project, Fisheries Effect Assessment. PIDP EA 012081, Caltrans Contract 04A0148. San Francisco - Oakland Bay Bridge East Span Seismic Safety Project

Casper, B.M., A. N. Popper, F. Matthews, T.J. Carlson, and M.B. Halvorsen MB (2012) Recovery of barotrauma injuries in Chinook salmon, *Oncorhynchus tshawytscha* from exposure to pile driving sound. PloS One. 7(6):e39593.

Cech, JJ and SI Doroshov. 2004. Environmental Requirements, Preferences, and Tolerance Limits of North American Sturgeons. Chapter 3 in Sturgeons and Paddlefish of North American. Kluwer Academic Publishers. GT LeBreton, FWH Beamish and RS McKinley, eds. pp. 73-86.

Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, Acipenser brevirostrum Lesueur 1818. NOAA Technical Report, NMFS 14, National Marine Fisheries Service. October 1984 45 pp.

de Neef, L., P. Middendorp and J. Bakker. 2013. Installation of Monopiles by Vibrohammers for the Riffgat Project. Pfahlsymposium, Braunschweig. http://www.allnamics.eu/wp-content/uploads/Riffgat_Pfahlsymposium_2013_de_Neef.pdf

Doksaeter, L., O.R. Godø, N.O. Handegard, P.H. Kvadsheim, F.P.A. Lam, C. Donovan, and P.J. Miller. 2009. Behavioral responses of herring (Clupea harengus) to 1-2 and 6-7 kHz sonar signals and killer whale feeding sounds. Journal of the Acoustical Society of America, 125: 554-564.

(EPA) Environmental Protection Agency. 1986. Quality Criteria for Water. Available at: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/2009_01_13_criteria_goldbook.pdf

ESS Group, Inc. (ESS). 2012. Renewal Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals Resulting from Pre- Construction High Resolution Geophysical Survey: Nantucket Sound. Prepared for Cape Wind Associates, LLC. Project No. E159-505.1. 66 pp.

Feist, B.E. 1991. Potential impacts of pile driving on juvenile pink (Oncorhynchus gorbuscha) and chum (O. keta) salmon behaviour and distribution. Master of Science thesis. University of Washington. Seattle, Washington.

German Federal Agency for Nature Conservation (Bundesamt für Naturschutz), 2013: Development of Noise Mitigation Measures in Offshore Wind Farm Construction. http://www.cbd.int/doc/meetings/mar/mcbem-2014-01/other/mcbem-2014-01- submission-noise-mitigation-en.pdf

Halvorsen, M.B., B.M. Casper, C.M. Woodley, T.J. Carlson, and A.N. Popper. 2011. Predicting and mitigating hydroacoustic effects on fish from pile installations. NCHRP Research Results Digest 363, Project 25-28, National Cooperative Highway Research Program, Transportation Research Board, National Academy of Sciences, Washington, D.C. http://www.trb.org/Publications/Blurbs/166159.aspx

Hastings, MC, and AN Popper. 2005. Effects of sound on fish. California Department of Transportation contract 43A0139 Task Order 1. Available at: http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_on_Fish23Aug05.pdf

Kane, A.S., J. Song, M.B. Halvorsen, D.L. Miller, J.D. Salierno, L.E. Wysocki, D. Zeddies, and A.N. Popper. 2010. Exposure of fish to high intensity sonar does not induce acute pathology. Journal of Fish Biology 76: 1825-1840.

Lovell, J.M., M.M. Findlay, R.M. Moate, J.R. Nedwell, and M.A. Pegg. 2005. The inner ear morphology and hearing abilities of the Paddle (Polydon spathula) and the Lake Sturgeon (*Acipenser fulvens*). Comp Biochem Physiol A Mol Integr Physiol. 142:286-289.

Meyer, M., R.R. Fay, and A.N. Popper. 2010. Frequency tuning and intensity coding of sound in the auditory periphery of lake sturgeon, *Acipenser fulvens*. Journal of Experimental Biology 213:1567-1578.

Minerals Management Service (MMS). 2009. Cape Wind Energy Project , Final Environmental Impact Statement (FEIS), January 2009. MMS EIS-EA. OCS 2008-040.

Mueller-Blenkle, C., P.K. McGregor, A.B. Gill, M.H. Andersson, J. Metcalfe, V. Bendall, P. Sigray, D.T. Wood, and F. Thomsen. 2010. Effects of Pile-driving Noise on the Behaviour of Marine Fish. COWRIE Ref: Fish 06-08, Technical Report. March 31, 2010.

Niklitschek, J. E. 2001. Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (Acipenser oxyrinchus and A. brevirostrum) in the Chesapeake Bay. Dissertation. University of Maryland at College Park, College Park.

Normandeau, Exponent, T. Tricas, and A. Gill. 2011. Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

Peake, SJ. 2004. Swimming and Respiration. Chapter 7 in Sturgeons and Paddlefish of North American. Kluwer Academic Publishers. GT LeBreton, FWH Beamish and RS McKinley, eds. pp. 147-166.

Plachta, D.T.T. and A.N. Popper. 2003. Evasive responses of American shad (Alosa sapidissima) to ultrasonic stimuli. Acoustic Research Letters Online 4: 25-30.

Popper, A. N., and Hastings, M. C. 2009a. The effects on fish of human-generated (anthropogenic) sound. Integrative Zool., 4:43-52.

Popper, A. N. and Hastings, M. C. 2009b. Effects of anthropogenic sources of sound on fishes. J. Fish Biol. 75:455-498.

Popper, A.N., M.B. Halvorsen, E. Kane, D.D. Miller, M.E. Smith, P. Stein, and L.E. Wysocki. 2007. The effects of high-intensity, low-frequency active sonar on rainbow trout. Journal of the Acoustical Society of America 122: 623-635.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Rogers, B.L. Southall, D.G Zeddies and W.N. Tavolga. 2014. ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles, Springer Briefs in Oceanography, DOI 10.1007/978-3-319-06659-2_1, Acoustical Society of America 2014.

Purser, J. and A.N. Radford. 2011. Acoustic Noise Induces Attention Shifts and Reduces Foraging Performance in Three-Spined Sticklebacks (Gasterosteus aculeatus). PLoS One 6: 1-8. February 2011.

Reyff, J. Underwater Sound Levels Associated with Construction of the Benicia-Martinez Bridge - Results of Measurements Made at Pier 13 with the UABC Operating. Produced by Illingworth & Rodkin, Inc. for Caltrans under Contract 43A0063, Task Order No. 18. April 2003.

Ruggerone, G. T., S.E. Goodman, and R. Miner. 2008. Behavioral response and survival of juvenile coho salmon to pile driving sounds. Prepared by Natural Resources Consultants, Inc. Prepared for Port of Seattle. July 2008.

RWE Innogy. 2014. Pilot project has started: Vibratory driving of monopiles can cut costs of offshore wind energy. https://www.rwe.com/web/cms/en/86182/rwe- innogy/news-press/press-release-09-july-2013-export-cables-in-at-gwynt-y-mr-offshore- wind-farm/?pmid=4010871

Secor, D. H., and E. J. Niklitschek. 2001. Hypoxia and sturgeons: Report to the Chesapeake Bay Program Dissolved Oxygen Criteria Team. Technical Report Series No. TS-314-01-CBL. Chesapeake Biological Laboratory, Solomons, Maryland.

Song, J., D.A. Mann, P.A. Cott, B.W. Hanna, and A.N. Popper. 2008. The inner ears of northern Canadian freshwater fishes following exposure to seismic air gun sounds. Journal of the Acoustical Society of America 124: 1360-1366. (http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC2680595).

Stadler, J.H. and D.P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. Inter-Noise 2009, Ottawa, Ontario, Canada. ftp://167.131.109.8/techserv/Geo-Environmental/Biology/Hydroacoustic/References/Literature%20references/Stadler%20and%20Woodbury%202009.%20%20Assessing%20the%20effects%20to%20fishes%20from%20pile%20driving.pdf (August 2009).

Stephenson, J.R, A. Gingerich, B. Brown, B.D. Pflugrath, Z. Deng, T.J. Carlson, M.J. Langeslay, M.L. Ahmann, R.L. Johnson, and A.G. Seaburg. 2010. Assessing barotrauma in neutrally and negatively buoyant juvenile salmonids exposed to simulated hydro-turbine passage using a mobile aquatic barotrauma laboratory. Fisheries Research 106: 271–278

Stokes, A., K. Cockrell, J. Wilson, D. Davis and D. Warwick. 2010. Mitigation of Underwater Pile Driving Noise During Offshore Construction: Final Report. Department of Interior, Minerals Management Service. Report Number M09PC00019-8. 104 pp.

ENCLOSURE TO 12/23/2014 NMFS LETTER

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

NOV 14 2011

MEMORANDUM FOR: The Record

FROM: for Patricia A. Kurkul
Regional Administrator

SUBJECT: Consideration of Final Rule for Loggerhead Sea Turtles and our Biological Opinion for the Cape Wind project

NOAA Fisheries Service (NMFS) has previously completed formal section 7 consultation with the Bureau of Ocean Energy Management (BOEM[1]) on the proposed Cape Wind energy project. We most recently issued a Biological Opinion to BOEM on December 30, 2010. The 2010 Opinion replaced an Opinion signed on November 18, 2008.

The recent ESA listing of nine Distinct Population Segments (DPS) of loggerhead sea turtles (*Caretta caretta*) has prompted a consideration of the 2010 Opinion in light of the change in the listing of loggerheads. The final rule, which went into effect on October 24, 2011, replaces the global listing of loggerheads by listing nine loggerhead DPSs distributed globally: (1) North Pacific Ocean DPS, (2) South Pacific Ocean DPS, (3) North Indian Ocean DPS, (4) Southeast Indo-Pacific Ocean DPS, (5) Southwest Indian Ocean DPS, (6) Northwest Atlantic Ocean DPS, (7) Northeast Atlantic Ocean DPS, (8) Mediterranean Sea DPS, and (9) South Atlantic Ocean DPS (76 FR 58868). The 2010 Opinion considers effects of the Cape Wind project on loggerhead sea turtles as listed globally. However, for the reasons described below, the effects analysis and jeopardy analysis included in these Opinions remains valid for the Northwest Atlantic DPS.

We have considered the available information on the distribution of sea turtles that originate from the 9 DPSs to determine the origin of any loggerhead sea turtles that may occur in the action area. Previous literature (Bowen *et al.* 2004) has suggested that there is the potential, albeit small, for some juveniles from the Mediterranean DPS to be present in U.S. Atlantic coastal foraging grounds. These conclusions must be interpreted with caution however, as they may be representing a shared common haplotype and lack of representative sampling at Eastern Atlantic rookeries rather than an actual presence of Mediterranean DPS turtles in US Atlantic coastal waters. A re-analysis of the data by the Atlantic loggerhead Turtle Expert Working Group has found that it is unlikely that U.S. fishing fleets are interacting with either the Northeast Atlantic loggerhead DPS or the Mediterranean loggerhead DPS (Peter Dutton, NMFS, Marine Turtle Genetics Program, Program Leader, personal communication, September 10, 2011). Given that the action area is a subset of the area fished by US fleets, it is reasonable to assume that based on

[1] BOEM was the lead Federal agency for consultation. The Opinion also considered effects of authorizations proposed by the Army Corps of Engineers and the Environmental Protection Agency.

this new analysis, no individuals from the Mediterranean DPS or Northeast Atlantic DPS would be present in the action area. Sea turtles of the South Atlantic DPS do not inhabit New England waters (Conant *et al.* 2009). As such, all loggerheads likely to be present in the action area for the Cape Wind consultation will have originated from the Northwest Atlantic DPS.

The effects analysis in the 2010 Opinion determined that a certain number of loggerhead sea turtles would be exposed to increased underwater noise during pre-construction surveys and during pile driving. The ITS exempted a certain level of take of loggerhead sea turtles by harassment. No injury or mortality is anticipated and none was exempted by the ITS.

The analysis in the 2010 Opinion considered the effect of this harassment on loggerheads originating from the western North Atlantic. The Opinion concluded that there would be no reduction in numbers, reproduction or distribution of loggerheads in the western North Atlantic. In the 2010 Opinion, we considered whether the proposed action would jeopardize the continued existence of the Northwest Atlantic DPS. In a section of the Opinion titled, "Proposed Rule to List Loggerhead Sea Turtles," we stated, "as the proposed action will not result in the injury or mortality of any loggerhead sea turtles, it is reasonable to expect that the conclusions reached for the Northwest Atlantic population and current range-wide listing would be the same as for the proposed Northwest Atlantic DPS."

There is no new information on the effects of the proposed action or any new information on loggerheads that change the determination reached in the 2010 Opinion. As such, we have determined that the conclusions reached in the 2010 Opinion remain valid for the Northwest Atlantic DPS. As such, it is not necessary to produce a new Biological Opinion to consider effects of the continued operation of this action on the Northwest Atlantic DPS. We have also determined that the incidental take statement (ITS) provided with the 2010 Opinion remains valid and will serve to exempt incidental take of loggerheads originating from the Northwest Atlantic DPS.

EC: Crocker – F/NER3
Collins – GCNE

File Code: Sec 7 BOEM Cape Wind
PCTS: F/NER/2010/03866

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

DEC 23 2014

Michelle Morin
Chief, Environment Branch for Renewable Energy
U.S. Department of the Interior
Bureau of Ocean Energy Management
Washington, D.C. 20240-0001

Re: Cape Wind Energy Project, Facilities Design Report and Fabrication and Installation Report (FDR/FIR) and revised Construction and Operations Plan (COP)

Dear Ms. Morin,

The Bureau of Ocean Energy Management's (BOEM) requested our concurrence with your determination that Cape Wind Associates' (CWA) July 25, 2014 Facilities Design Report and Fabrication and Installation Report (FDR/FIR) and revised Construction and Operations Plan (COP) do not require reinitiation of consultation pursuant to Section 7 of the Endangered Species Act (ESA). In particular, BOEM has determined that reinitiation is not required because the modifications to the identified action will not cause any affects to listed species or critical habitat not previously considered in the 2010 Biological Opinion. We agree with your determination. Our supporting analysis is presented below.

Changes to the Proposed Action

A description of the proposed action was included in the 2010 Opinion. We incorporate that description by reference. With the exception of what is described below, the proposed action remains as it was described in the December 30, 2010 Opinion.

Timing of Construction

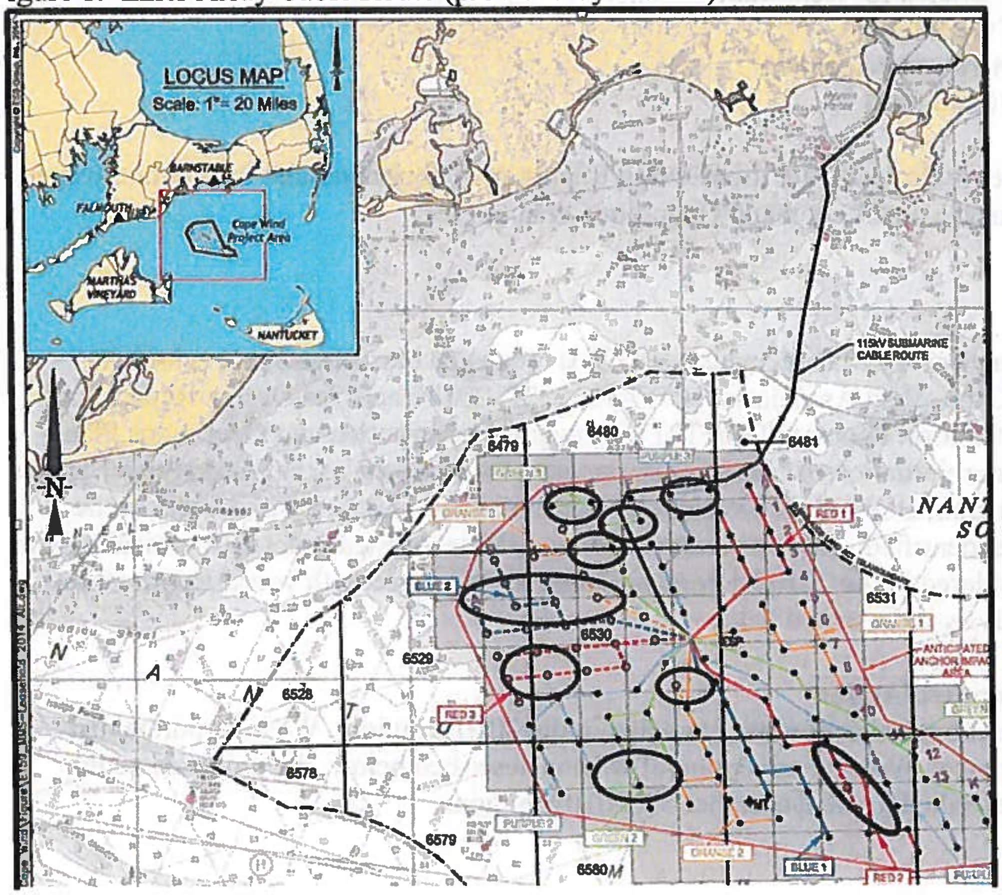
In the 2010 Opinion, we stated that construction was planned to take place over a 5-9 month period between April and November, the full period of which would result in construction occurring over two seasons. CWA has provided BOEM with additional details on the construction schedule that clarify when different activities will take place. In the July 2014 COP, CWA states that during the first season of construction ("Season A", currently scheduled to occur between April and August 2015), the monopiles to support 101 turbines would be installed. During the second season, the remaining 29 monopiles will be installed ("Season B", commencing after April 2016). Installation of scour protection will follow monopile installation in the same year. Intra-array cable installation would also follow in the same year as monopile installation. Submarine cable installation (connection to shore) would occur in the second construction season (2016). In-water construction work for the Electrical Service Platform

(ESP) is currently scheduled for the first season with topside work scheduled for the second season.

Inner-Array Cable Route

CWA has made minor modifications to the inner array cable routing. In addition, the total length of the cable route is increased to 70 miles from 66.7 miles, an increase of approximately 3.3 miles. The inner array cable route is illustrated in Figure 1. As illustrated in Figure 1, cable installation will occur in two construction seasons.

Figure 1. Inner Array Cable Route (provided by BOEM)



Legend

- Solid lines are Season A cables
- Dashed lines are Season B cables
- Ovals indicate areas of cable route changes from original COP

Electrical Service Platform Design

The ESP's fixed template-type jacket frame foundation system (COP section 4.1.5) has been revised from the originally proposed single, large, jacket frame anchored with 6 driven foundation piles to an updated design that requires two smaller, separate, jacket frames, each anchored with 4 driven foundation piles (for a total of 8 piles). The diameter of the piles (approximately 42") remains unchanged. The COP (p. 84) describes the installation of the ESP jackets as follows: "The jacket will be transported to the site on a jack up transport barge. Once on site, the jacket is expected to be lifted from the transport barge by a crane mounted on a separate jack up barge." The jackets will be installed from a floating barge rather than a jack up barge. The topside installation procedure is a float-over and remains as described in the COP.

The dimensions of the ESP have also changed. The ESP will be smaller (132' x 115' (15,180 square feet; compared to 100' x 200' (20,000 square feet as originally planned) and will not rise as far off the water. The first deck will be approximately 35' above MLLW and rising 47' to the roof compared to the original design of the 1st deck of the ESP to be approximately 39' above MLLW and rising 49' to the roof.

CWA is also planning to install 3 rather than 4 transformers at the ESP, with a total of 30,000 gallons of transformer cooling oil (compared to 40,000 gallons originally considered).

Pile Installation
CWA plans to use an IHC S-1800 hydrohammer, a Menck 1900S impact hammer or an equivalent hydraulic impact hammer with a comparable energy rating to drive the monopiles to grade.

BOEM will require that CWA employ a noise attenuation system (NAS) during pile driving operations to ensure that: the radius of the 180 dB re 1uPa peak isopleth does not extend beyond 750 m; the radius of the 160 dB re 1uPa RMS isopleth does not extend beyond 3.4 km during impact pile driving; and, the radius of the 120 dB re 1uPa RMS isopleth does not extend beyond 3.4 km during vibratory pile driving. CWA is proposing to use a large bubble curtain system as a noise attenuation system (NAS) for all pile driving. Sound source verification will be required for the first pile installed with the impact hammer and the first time a vibratory hammer (see below) is used. If the size of these isopleths is greater than these distances, BOEM will require CWA to employ additional mitigations that are effective in achieving the required reductions. BOEM confirms that should an additional sound barrier be needed, the bubble curtain system has the inherent flexibility to accommodate this requirement.

BOEM estimates that while specific actual installations will vary in performance, a single bubble curtain is predicted to reduce noise levels by 8-14 dB (peak). This prediction is considered to be an effective quantification of relative performance that can be used to support the evaluation of potential pile installations (Stokes *et al.* 2010). A report published by the German Federal Agency for Nature Conservation (2013) documents that reductions of 8-14 dB (peak) were achieved with the single ring bubble curtain in water depths from 23-33 m.

The bubble curtains act as a direct reduction of the source level. Assuming standard 20 log(R) spherical spreading (as described in BOEM's effects analysis this is a reasonable assumption considering the relatively shallow depths and short distances being discussed), a single bubble ring will result in noise levels as described in Table 1. Modeling has not been carried out for installation of the 8 42" piles that will support the ESPs. However, because underwater noise is directly related to pile diameter (i.e., larger diameter steel piles will be louder than smaller diameter steel piles when installed in the same area with the same equipment; Illingworth and

Rodkin 2007), the results presented in Table 1 represent an extreme worst case for the eight 42" piles, which are about 20% the diameter of the monopiles.

Boulder Mitigation

Geotechnical and geophysical investigations on the Project Site have confirmed that the site is potentially populated with a variety of large glacial erratics (boulders) on the surface of and in the top 10 m of the soil matrix. In the event that a boulder is encountered during the installation of a monopile, CWA has proposed the use of four possible methodologies to mitigate for boulders: driving through a boulder with the impact hammer, use of a vibratory hammer, clamshell extraction or drilling through the boulder. Boulder mitigation was not described as part of the proposed action in the 2010 Opinion.

Driving through a boulder with the impact hammer

Foundation monopiles are designed to be driven to full penetration with a hydraulic impact hammer. If a boulder is encountered during driving, the selected hammer may drive through the boulder. According to BOEM, this has been successfully done on European projects.

Vibratory hammer

Test installations have been done using vibratory hammers on European offshore wind projects (de Neef et al., 2013) and more are in progress (RWE Innogy, 2014). BOEM states that fatigue analysis has shown that using the vibratory hammer is within the foundation design standards and will allow multiple attempts of re-driving the pile. A pile that is partially driven and encounters refusal due to a boulder could be extracted by the vibratory hammer and moved to a new location. Further engineering analysis is underway to confirm the suitability of this option. If a vibratory hammer is chosen as the preferred boulder mitigation method, CWA will use the Cape Holland Super Triple Kong vibratory hammer system. The Super Triple Kong is comprised of three APE 600 vibratory driver/extractors.

Clamshell extraction

Given the large diameter of the monopiles, it may be possible to extract the boulder from inside the monopile with a clamshell dredge. This is potentially the fastest method, but its effectiveness depends on site-specific conditions.

Drilling

A drill that fits closely inside the monopile could be lowered to the soil plug present at approximately the seabed elevation. As the drill is rotated and advanced to the boulder, a reverse circulation (airlift) process will be used to remove the cuttings in a controlled manner through the center drill pipe. Driven by the water pressure and the rapid expansion of the injected air, an air- water mixture will quickly flow upwards in the drill pipe, pulling the drill cuttings along with the flow. The cross-flow of water from the drill annulus below the full-face bit will carry drill cuttings to the center pipe and subsequently to the surface for disposal by appropriate means. It may be necessary to deploy under-reaming bits to clear the boulder from below the pile tip, and once the obstruction has been passed, the drill will be retracted and the monopile will be advanced again by a hydraulic or vibratory hammer.

Table 1: Sound source levels for equipment to be used during Cape Wind construction operations (provided by BOEM)

Source	RMS noise level at distance from source			Peak noise level at 1m
	1m	750m	3400m	1m
Impact Hammer IHC S1800	235	178	164	241
Impact Hammer Menck 1900 S	235	178	165	241
Vibratory hammer	204	147	134	220
Clamshell Dredge	153	96	83	163
Drilling	124	67	54	127

Scour Protection

In the 2010 Opinion, we considered the effects of both scour mats and rock armor for scour protection at each of the turbine foundations. The use of scour mats is no longer being considered. Rock armor will be used as described in the 2010 Opinion. The only change is that prior to either filter or armor stone placement, a multi-beam survey will be performed to create a baseline for quality control of layer thickness/position and for As-Built documentation. Real time surveying of the rock placing work will be performed utilizing multi-beam sonar equipment during placing operations as a quality control measure to ensure the rock is placed in the correct location and thickness. Once the quality control surveys have shown the scour design parameters have been met, a final survey of both the filter and armor layers will be performed to be incorporated as the As-Built documentation.

Other Changes

Other changes to the proposed action include the change of the connector transitioning the cables from the seabed into the foundation termination point, from a "J-tube" design, to one utilizing a Tekmar cable protection system. The revised COP also incorporates the superseding provisions of the interim Marking and Lighting Changes issued by the FAA on May 25, 2014, and further provides that the Project will at all times conform to the FAA requirements that are in effect. These revisions will have no effect to marine ESA-listed species because they involve changes to the project above the water where these species do not occur and their effects do not extend into the marine environment. Therefore, these revisions are not further assessed in this document.

Effects of Proposed Changes on right, humpback and fin whales and loggerhead, Kemp's ridley, green and leatherback sea turtles

Construction Schedule

In the 2010 Opinion, we considered that all in-water construction of the 130 WTGs would occur over a 5-9 month period between April and November and that construction could occur in two construction seasons. The additional details provided on the construction schedule do not change the time of year when construction will take place nor do they change the types of activities that will occur. Therefore, the additional details on construction schedule do not introduce any effects not considered in the 2010 Opinion.

Inner Array Cable Route
In the 2010 Opinion, we considered the effects of installation and maintenance of 66.7 miles of submarine cable. CWA is now proposing to install approximately 70 miles of cable, an increase of about 3.3 miles (5%). No changes to the installation methodology are proposed. Effects considered in the Opinion included: the potential for interactions with the cable laying equipment; temporary loss of benthic resources for foraging sea turtles; exposure to increased turbidity and suspended contaminants; and exposure to the cable's electromagnetic field (EMF). It is important to note that the 3.3 miles of additional cable will occur in the same locations we considered for installation of cable in the 2010 Opinion. In the 2010 Opinion, we considered effects of installation of the cable via jetplow. We analyzed the potential for interactions with the cable laying equipment as well as the effects of destruction of prey, loss of benthic resources, turbidity, suspended sediments and exposure to the cable's electromagnetic field. We concluded that all effects of cable installation to listed whales and sea turtles would be insignificant and discountable. The small increase in the amount of cable to be installed does not introduce any new effects that were not considered in the 2010 Opinion. The effects previously analyzed would also occur over the extra 3.3 miles. However, given the installation methodology and habitat characteristics are the same for the extra 3.3 miles of cable, we expect the additional effects would also be insignificant and discountable as would the aggregate effects of laying the full 70 miles of cable.

Electrical Service Platform
In the 2010 Opinion, we considered the acoustic impacts of installing piles to support the ESP as well as effects to benthic habitat and prey resources from the construction and operation of the ESP. Construction of the ESP will now involve the driving of eight 42-inch diameter piles instead of six 42-inch piles. This is less than a 1.5% change in the total amount of piles to be driven for the entire project, when compared to the 2010 Opinion. Effects of pile driving are discussed below. The additional two piles will result in a slight increase in the amount of benthic disturbance (<2 m^2 of additional impact); however, that increase is so small it would not have a detectable impact on listed species. The effects to listed whales and sea turtles from an ESP supported by eight piles will be the same as the effects of an ESP supported by six piles. These modifications to the ESP foundation configuration present a very minor, insignificant change in the impacts previously identified and evaluated in the 2010 Opinion.

As noted in the 2010 Opinion, an oil spill would be an unintended, unpredictable event. The ESP will now house three transformers instead of the four considered in the 2010 Opinion. This results in a 25% reduction in the amount of transformer cooling oil on the ESP. There are no effects to listed whales or sea turtles from the storage of a smaller amount of cooling oil on the ESP that were not considered in the 2010 Opinion.

In the 2010 Opinion, we considered that the ESP would be installed from a jack-up barge. CWA is now proposing to use a floating barge for installation of the ESP. The impacts to the benthos from the floating barge are expected to be the same as for a jack-up barge as a similar area of the bottom will be disturbed; there are no effects of using a floating barge that were not considered in the 2010 Opinion.

Construction Methodology

Pile Driving

The possible acoustic effects of pile driving during project construction on marine mammals and sea turtles are discussed in detail in the 2010 Opinion. Effects of pile installation considered in the Opinion included acoustics (potential for injury and behavioral disturbance), water quality (turbidity) and impacts to benthic resources and habitat. The piles are the same size considered in the 2010 Opinion and the general installation method remains the same (pile driving). The installation of two additional piles will result in a very minor, insignificant impact on water quality, benthic resources or habitat that will not have a detectable effect on listed species incrementally or in the aggregate. Here we consider further the acoustic effects of pile installation. As explained in the 2010 Opinion, we considered the potential for injury to listed whales if exposed to underwater noise louder than 180 dB re 1uPa RMS and the potential for a behavioral response to impulsive noise of 160 dB re 1uPa RMS or louder and continuous noise of 120 dB re 1uPa RMS or louder. For sea turtles, we do not anticipate any potential for injury upon exposure to noise less than 180 dB re 1uPa RMS and do not expect any behavioral response to noise less than 160 dB re 1uPa RMS.

<u>Right, humpback and fin whales</u>

In the 2010 Opinion, we summarized the best available information on the presence of right, humpback and fin whales within Nantucket Sound. We stated that "a review of sightings data compiled by the Northeast Fisheries Science Center, CeTAP study data, the OBIS database, and status of the stock reports indicate that whales are rare visitors to Nantucket Sound, with no sightings of large whales within Horseshoe Shoal."

We determined that "humpback whale occurrence in Nantucket Sound is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of Nantucket Sound (i.e., near Monomoy). The shallow depths of Nantucket Sound and its location outside of the coastal migratory corridor likely minimizes the potential for humpback whales to occur in Nantucket Sound." We also determined that "fin whale occurrence in Nantucket Sound is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of this area, most likely between April and October." We have reviewed Stock Assessment Reports produced since the 2010 Opinion (Waring *et al.* 2014, 2013, 2012, and 2011) and other available sources of large whale sightings (e.g., the OBIS database[1]) and find no additional sightings of humpback or fin whales in Nantucket Sound.

In the 2010 Opinion, we stated that "occasional right whales have been reported off Monomoy and off Great Point, Nantucket (northern tip of the island) but right whales have only rarely been documented in Nantucket Sound (NEFSC unpublished data, Waring *et al.* 2010), and no right

---

[1] Available at: seamap.env.duke.edu

whales have been sighted on Horseshoe Shoal." Only one historical source included information for a whale in Nantucket Sound. Mate *et al.* (1997) reports data for several North Atlantic right whales outfitted with satellite tags. One right whale female, tagged in the Bay of Fundy on August 24, 1990, transited Nantucket Sound in 1997 accompanied by her calf. However, this whale was only present in Nantucket Sound for a brief period of time (i.e., less than one day) and moved rapidly during that time (i.e., approximately 89.6km/day or 3.7km/hour). We also reported sightings of right whales in or near Nantucket Sound in April and May 2010. We have reviewed right whale sightings data from January 2011 – November 2014 and note that of the hundreds of right whale sightings reported during this period, there were only three sightings recorded on the NEFSC RWSAS during that period (one right whale on April 27, 2011 reported at 41.472, -70.1862; a group of three on April 25, 2011 (reported at 41.5833, -70.1545) and a group of 3 on July 7, 2013 reported at 41.5, -70.5). Additionally, a mother/calf pair was spotted just east of Great Point on April 28, 2013 (reported at 41.3833, -70.05). None of these whales were observed within the area where WTGs will be installed, and the closest whale reported was 4.6 km from the edge of the WTG footprint (see Figure 2a, b, c and d). As stated in the 2010 Opinion, the best available information indicates that like the other large whale species, right whale occurrence in Nantucket Sound is rare, with transient individuals likely to overlap only sporadically (i.e., for less than one day and on no more than a few days per year) with the Nantucket Sound portion of the action area between December and June. There is no new information on the use of the action area by listed whales that would reveal effects of the action not considered in the 2010 Opinion.

Figure 2a. Location of three right whales reported on April 25, 2011. Location Information obtained from Right Whale Sightings Advisory System (http://www.nefsc.noaa.gov/psb/surveys/). Basemap with proposed Cape Wind turbine location obtained from Massachusetts Ocean Resource Information System (MORIS); (http://maps.massgis.state.ma.us/map_ol/moris.php). Distance from sighting to nearest proposed turbine = 14.02km

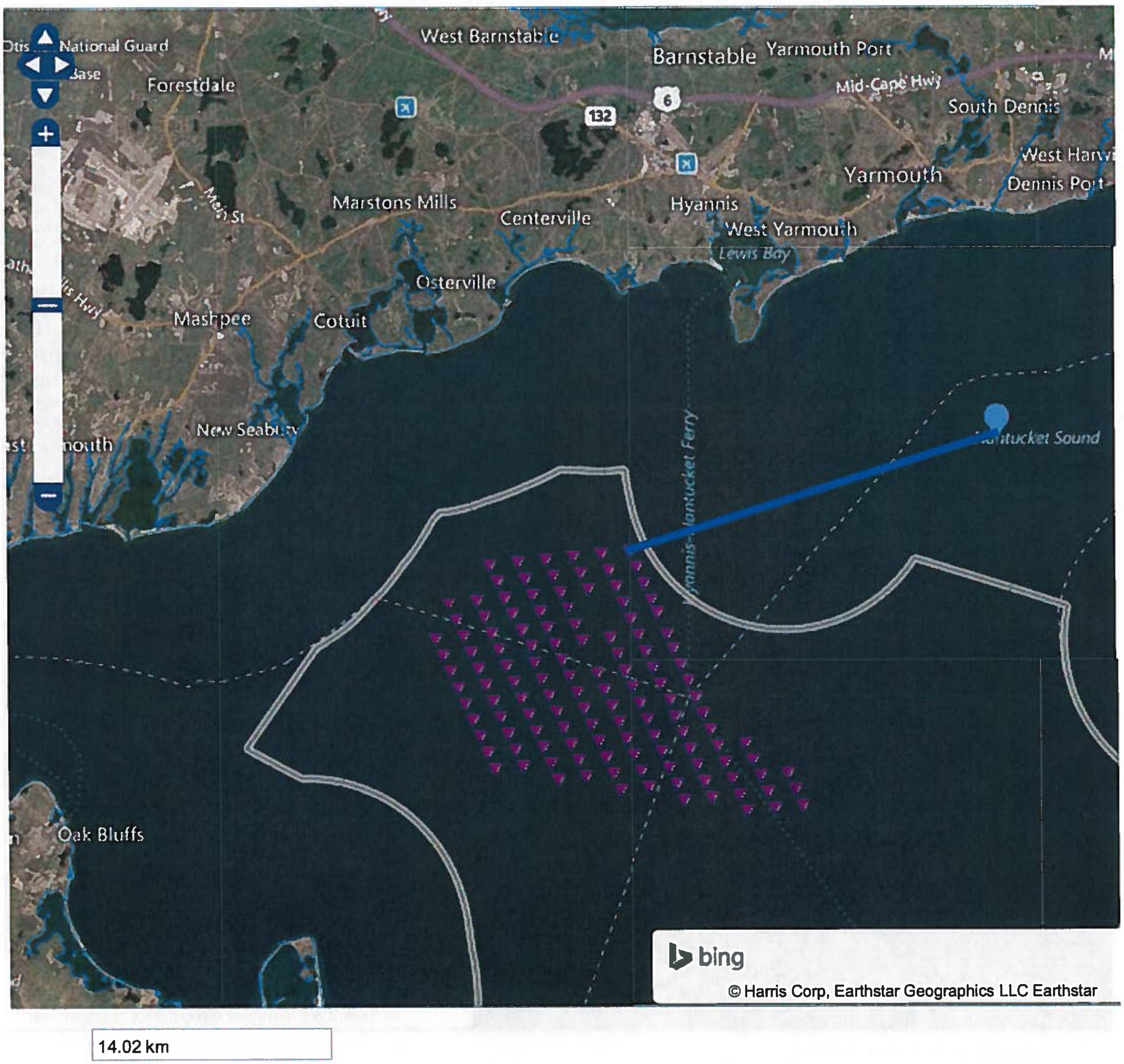


Figure 2b. Location of single right whale reported on April 27, 2011. Location Information obtained from Right Whale Sightings Advisory System (http://www.nefsc.noaa.gov/psb/surveys/). Basemap with proposed Cape Wind turbine location obtained from Massachusetts Ocean Resource Information System (MORIS); (http://maps.massgis.state.ma.us/map_ol/moris.php). Distance from sighting to nearest proposed turbine = 4.64 km

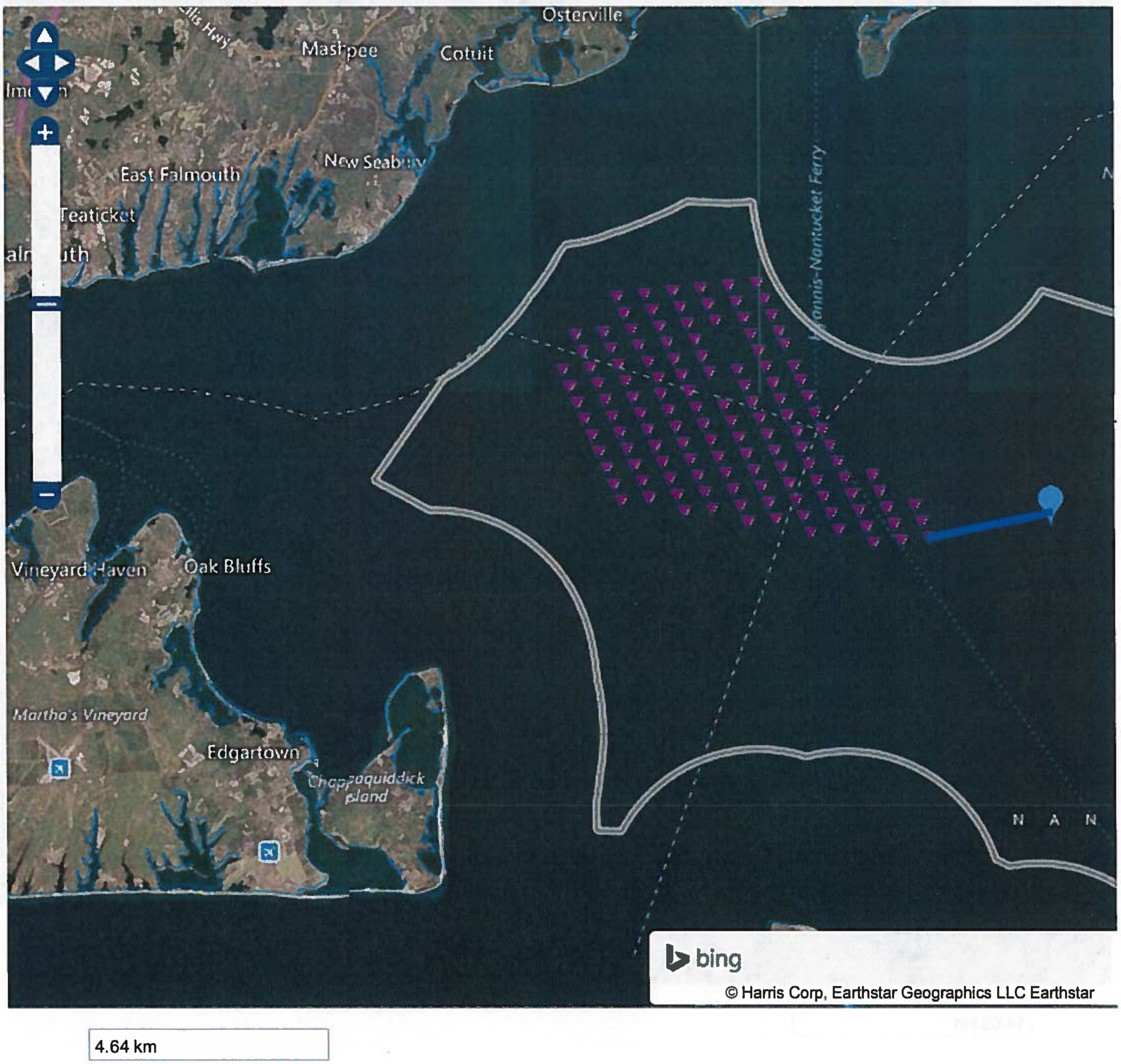


Figure 2c. Location of three right whales reported on July 7, 2013. Location Information obtained from Right Whale Sightings Advisory System (http://www.nefsc.noaa.gov/psb/surveys/). Basemap with proposed Cape Wind turbine location obtained from Massachusetts Ocean Resource Information System (MORIS); (http://maps.massgis.state.ma.us/map_ol/moris.php). Distance from sighting to nearest proposed turbine = 8.8km

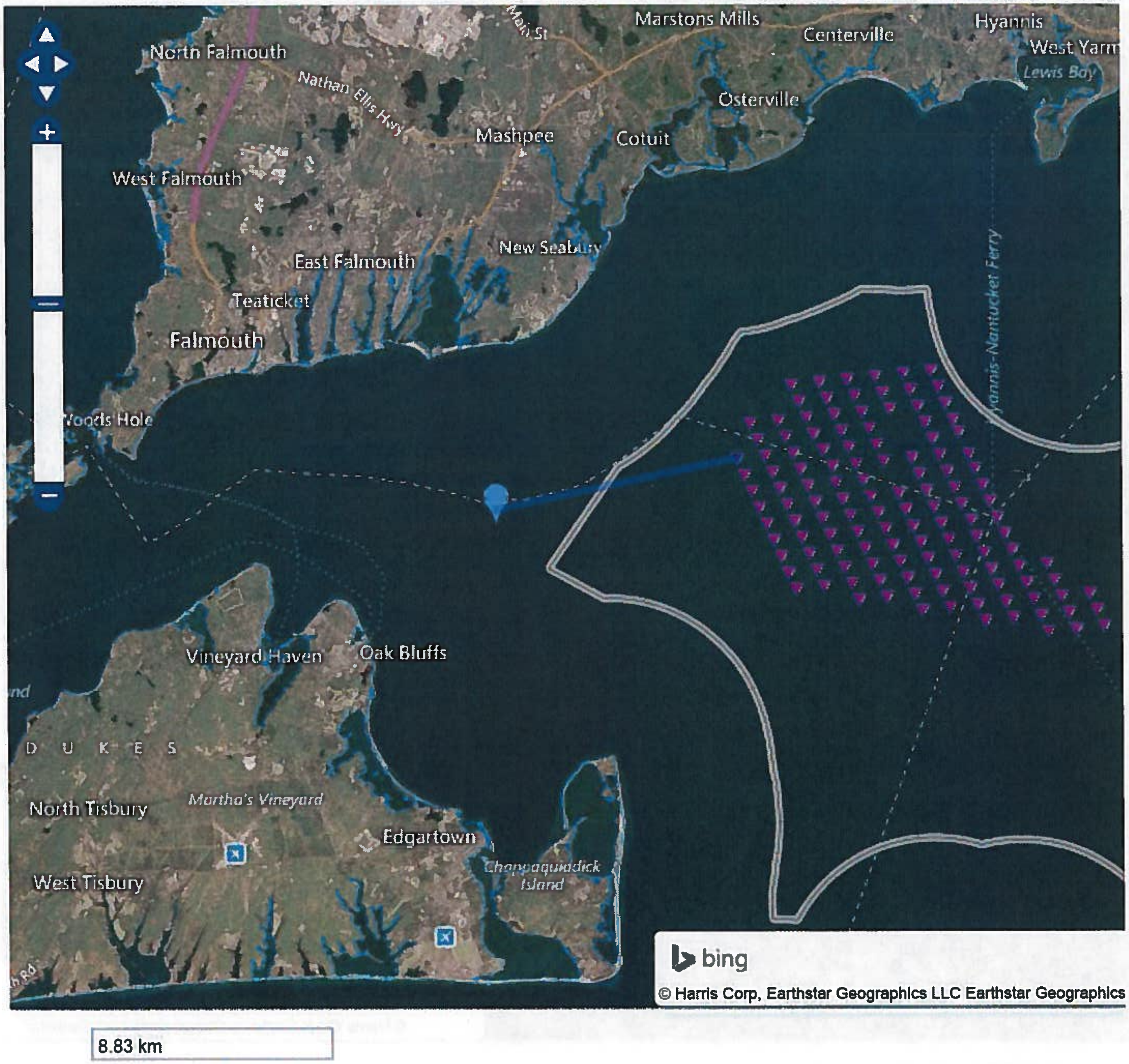


Figure 2d. Location of mother/calf pair of right whales reported on April 28, 2013. Location Information obtained from Right Whale Sightings Advisory System (http://www.nefsc.noaa.gov/psb/surveys/). Basemap with proposed Cape Wind turbine location obtained from Massachusetts Ocean Resource Information System (MORIS); (http://maps.massgis.state.ma.us/map_ol/moris.php). Distance from sighting to nearest proposed turbine = 18.6km

In the 2010 Opinion, we determined that no right, humpback or fin whales would be exposed to potentially injurious or disturbing levels of underwater noise. Here, we review the additional information now available on the precise methodology and equipment to be used to install the ESP and WTG piles.

Use of Impact Hammer

As explained above, the source levels (i.e., the underwater noise expected at 1m from the pile being driven) presented by Cape Wind in their July 2014 filing are louder than the source levels assessed in the 2010 Opinion (241 dB re 1uPa peak with the impact hammer). In the Opinion, we state that we do not anticipate any whales will be present on Horseshoe Shoals during pile installation and therefore, no whales will be exposed to increased underwater noise resulting from pile driving. We also state that in the unlikely event that a whale is within Nantucket Sound during pile driving, the maintenance of the 750m monitored exclusion zone will ensure that no whales will be exposed to potentially injurious levels of underwater noise. Large whales may experience injury upon exposure to noise of 180 dB re 1uPa or louder. In the 2010 Opinion, we considered the effects of pile driving with the 180 dB re 1uPa RMS isopleth extending 500 m from the pile being driven and determined that it was extremely unlikely that any listed whales would be exposed to injurious levels of noise during pile driving. With the noise attenuation system (NAS), the 180 dB re 1uPa RMS isopleth will extend only 3.2-150 m from the pile being driven. It is reasonable to expect that the observer will be able to spot any whale that is within 750 meter exclusion zone. The observer will monitor the exclusion zone for 60 minutes prior to pile driving commencing. Right whales have a maximum dive time of 40 minutes. Because the monitoring period is longer than the maximum dive time, any whale submerged within the exclusion zone would need to come to the surface during the pre-driving monitoring period. We expect an observer would detect either the body of the whale, which is large, or the distinctive blow produced several feet above the water surface when the whale takes a breath. Because pile driving will not occur if conditions are such that the observer cannot adequately monitor the entirety of the exclusion zone, pile driving will not occur when sea surface or weather conditions are such that an observer would not be able to detect a whale in the exclusion zone. As CWA will be maintaining an exclusion zone with a radius of 750m (i.e., no pile driving will occur if a whale was within 750 m of the pile being driven) and the extent of the area with potentially injurious levels of noise extends no more than 150m, it is our determination that it is extremely unlikely any listed whales will be exposed to injurious levels of noise during pile driving. Therefore, our determination that whales are not likely to be adversely affected by levels of noise produced during pile driving remains valid.

In the 2010 Opinion, we considered that the 160 dB re 1uPa RMS isopleth would extend up to 3.4 km from the pile being driven. With the NAS, Cape Wind estimates that the 160 dB re 1uPa RMS isopleth will extend 680-1,360m from the pile being driven. BOEM will continue to require monitoring of a zone extending 3.4km from the pile being driven in order to document the presence of any listed species within this area during pile driving. With the NAS in place, the size of the area with potentially disturbing levels of noise (i.e., between 160 and 180 dB re 1uPa RMS) will be smaller than that considered in the 2010 Opinion (up to 4.05 km^2 with NAS compared to 34.56 km^2 considered in the 2010 Opinion). In the 2010 Opinion, we concluded that it is was extremely unlikely that any listed whales would be within 3.4 km of any pile being driven and therefore, effects of pile driving noise on listed whales was discountable. As the extent of the 160 dB re 1uPa RMS isopleth will be even smaller than that considered in the 2010 Opinion, our conclusions remain the same. Additionally, as BOEM will require that Cape Wind monitor the SAS, in the unlikely event that any whales are present within Nantucket Sound, the location of these whales can be monitored and pile driving could be delayed until any whales leave the area. Based on the best available information and the analysis outlined herein, no right, humpback or fin whales will be exposed to noise levels greater than 160 dB. As such, no whales will be exposed to noise levels that could result in behavioral disturbance or harassment.

Cape Wind will install two more piles than considered in the 2010 Opinion. Given the precautions that will be taken to ensure that no pile driving occurs in the rare event that a whale is present within Nantucket Sound, the installation of two additional piles to support the ESP will not cause any effects not considered in the 2010 Opinion. Based on our analysis, the changes in the proposed action regarding the characteristics of the pile driving hammer, the installation of two additional 42" piles for the ESP, and the new requirement to use a bubble curtain, will not result in any effects to whales that were not considered in the 2010 Opinion.

Use of Vibratory Hammer

In the 2010 Opinion, we noted that vibratory and impact hammers would be used; however, the noise analysis was based on estimates for impact hammers. Cape Wind may use a vibratory hammer for boulder mitigation. Peak noise (at 1 m from the pile) for piles being installed with a vibratory hammer is estimated at 220 dB re 1uPa. Without a NAS, noise will attenuate to 147 dB re 1uPa RMS at 750 m and 134 dB re 1uPa RMS at 3.4 km. A monitored 750m exclusion zone will be maintained when the vibratory hammer is used; this ensures that no whales will be exposed to potentially injurious noise during vibratory pile installation. Vibratory pile installation is considered a continuous noise source. Criteria for assessing potential behavioral disturbance of whales are 120 dB re 1uPa RMS for continuous noise sources such as vibratory pile drivers. Whales are not likely to react behaviorally to underwater noise less than 120 dB. With the single bubble curtain providing a 14 dB reduction, noise will attenuate to 120 dB re 1uPa RMS at 3.1 km from the pile. BOEM states that if monitoring reveals that the single bubble curtain does not perform as expected, a second bubble curtain will be required. With a double curtain, expected to provide a 20 dB reduction, the distance to 120 dB re 1uPa is only 1.5 km. This is smaller than the zone of potentially disturbing level of noise considered in the 2010 Opinion (1.5-3.1 km radius compared to 3.4 km radius); therefore, there are no effects to listed whales not considered in the 2010 Opinion.

<u>Sea Turtles</u>

In the 2010 Opinion, we assessed the effects of exposure of Kemp's ridley, green, loggerhead and leatherback sea turtles to increased underwater noise resulting from installation of 6 piles to support the ESP and 130 WTG foundation piles. We determined that injury could result from exposure to underwater noise louder than 180 dB re 1uPa RMS and that exposure to noise 160 dB re 1uPa RMS or louder could result in behavioral disturbance. We determined that the number of sea turtles that would be exposed to noise levels between 160 and 180 dB re 1uPa RMS ranges between 3 and 7 for each pile installed.

Use of Impact Hammer
As explained above, the source levels (i.e., the underwater noise expected at 1m from the pile being driven) presented by Cape Wind in their July 2014 filing, are louder than the source levels assessed in the 2010 Opinion (241 dB re 1uPa peak with the impact hammer). As part of the proposed action considered in the 2010 Opinion, Cape Wind would use observers to maintain a 750m exclusion zone. That is, they would ensure that no pile driving took place if a sea turtle was within 750m of the pile being driven. This was to ensure that no sea turtles would be exposed to potentially injurious levels of underwater noise (expected to be experienced within 500m of the pile being driven). Now, Cape Wind is proposing to use a noise attenuation system (NAS; likely a single bubble curtain) as well as maintaining the 750m exclusion zone. Without the NAS, the extent of the 180 dB re 1uPa RMS isopleth is the same as was considered in the 2010 Opinion (noise attenuated to 178 dB re 1uPa RMS for the impact hammer). With the NAS, the 180 dB re 1uPa RMS isopleth will extend only 3.2-150 m from the pile being driven. As Cape Wind will be maintaining an exclusion zone with a radius of 750m, our determination that sea turtles are not likely to be adversely affected by levels of noise produced during pile driving remains valid.

In the 2010 Opinion, we considered that the 160 dB re 1uPa RMS isopleth would extend up to 3.4 km from the pile being driven. Without the NAS, Cape Wind now estimates that this isopleth would extend beyond 3.4 km, with noise levels at a distance of 3.4km at 164-165 dB re1uPa during impact hammering. With the NAS, Cape Wind estimates that the 160 dB re 1uPa RMS isopleth will extend 680-1,360m from the pile being driven. BOEM will continue to require monitoring of a zone extending 3.4km from the pile being driven in order to document the presence of any sea turtles within this area during pile driving. With the NAS in place, the size of the area with potentially disturbing levels of noise (i.e., between 160 and 180 dB re 1uPa RMS) will be smaller than that considered in the 2010 Opinion (up to 4.05 km^2 with NAS compared to 34.56 km^2 considered in the 2010 Opinion). Using the same methodology from the 2010 Opinion (i.e., number of sea turtles per square kilometer (0.09-0.19) multiplied by the size of the area where noise levels will be between 160 and 180 dB re 1uPa RMS), we estimate that no more than 1 (calculated 0.36-0.77) sea turtles will be exposed to potentially disturbing levels of noise during each pile driving event.

Cape Wind will install two more piles than considered in the 2010 Opinion. Even with these additional piles, the number of sea turtles expected to be exposed to potentially disturbing levels of noise will be less than considered in the 2010 Opinion (1 x 138 piles = 138 sea turtles exposed to potentially disturbing levels of noise vs. 3-7 x 136 piles = 408-952 sea turtles exposed to potentially disturbing levels of noise). The acoustic effects of pile installation will be less than those considered in the 2010 Opinion. There are no new effects introduced by the changes considered here.

Use of Vibratory Hammer
In the 2010 Opinion, we noted that vibratory and impact hammers would be used; however, the pile installation noise analysis was based on estimates for impact hammers. Cape Wind may use a vibratory hammer for boulder mitigation. Peak noise (at 1 m from the pile) for piles being installed with a vibratory hammer is estimated at 220 dB re 1uPa. Without a NAS, noise will attenuate to 147 dB re 1uPa RMS at 750 m and 134 dB re 1uPa RMS at 3.4 km. A 750m

exclusion zone will be maintained when the vibratory hammer is used. Sea turtles are not likely to react behaviorally to underwater noise less than 166 dB (McCauley 2000). Noise will attenuate to below 166 dB within the exclusion zone. Therefore, when the vibratory hammer is used, we do not anticipate that any sea turtles will be exposed to potentially injurious or disturbing levels of noise. In the 2010 Opinion, we did not anticipate any sea turtles would be exposed to injurious levels of noise. Therefore, the conclusions reached here are consistent with those reached in the 2010 Opinion.

Boulder Mitigation with Clamshell Dredge and Drilling

A 750m exclusion zone will be maintained anytime a clamshell dredge or drilling is used. Drilling is considered a continuous noise source, a clamshell dredge would be considered a non-continuous noise source. For the clamshell dredge, at 1m from the source noise will be 153 dB re 1uPa RMS, below the level that could result in injury to whales or sea turtles. Noise will have attenuated to background levels at 750m. Therefore, there is no potential for injury or behavioral disturbance when the clamshell dredge is used. Noise within 1m of the drill will be 124 dB re 1uPa; therefore there is no potential for injury. Noise will attenuate to below background levels within 750 m; therefore there is no potential for behavioral disturbance. Given this, it is extremely unlikely that the use of a clamshell dredge or drill will result in injury or behavioral disturbance of any whales or sea turtles. All acoustic effects of boulder mitigation during pile installation will be insignificant and discountable. Because the clamshell dredge and the drill will be operated inside of the hollow pile, we do not anticipate any other effects of use of the clamshell dredge or the drill; therefore, there will be no effects not considered in the 2010 Opinion.

Scour Protection

In the 2010 Opinion, we considered effects of installation of two scour protection alternatives, scour mats and rock armoring. Cape Wind is now proposing, and BOEM has approved, the use of rock armor. No changes to the amount of rock armor to be placed or to the installation methods are proposed. In the Opinion we determined that all effects of the installation and continued use of rock armor would be insignificant and discountable. These conclusions remain valid. Cape Wind is now proposing to carry out multi-beam surveys to inspect the rock armor deployments. The multi-channel multi-beam depth sounder operates at frequencies between 200-400 kHz (ESS, 2012). The multi-beam surveys will be focused at the WTG foundations on Horseshoe Shoals. No listed whales are expected to occur in the area where the rock armor inspections will occur. However, even if a listed whale was present near the survey, the equipment operates at a frequency that listed whales cannot hear; based on the best available information, sources with frequencies above 180 kHz do not appear to be perceived by these species (Richardson et al. 1995; Ketten 1998). Therefore, there would be no effect of any listed whales. Similarly, while listed sea turtles are seasonally present in the area where the survey will take place, the multi-beam depth sounders operate at frequencies above the hearing abilities of sea turtles. The information available for sea turtle hearing suggests that the auditory capabilities of sea turtles are centered in the low frequency range between 100 Hz and 2,000 Hz (Ridgway *et al.* 1969; Lenhardt *et al.* 1983; Bartol *et al.* 1999, Lenhardt 1994, O'Hara and Wilcox 1990). The only change in the scour protection protocol is the use of the multibeam survey. There are no effects of this survey on whales and sea turtles. Therefore, the changes to the scour protection do not introduce any effects to listed whales or sea turtles that were not considered in the 2010 Opinion.

Conclusion

In the 2010 Opinion, we anticipated incidental take of sea turtles (harassment) from exposure to increased underwater noise during the pre-construction geophysical surveys and during the installation of piles to support the construction of the ESP and the 130 WTGs. No incidental take was anticipated to result from any other activities such as construction, operation and decommissioning because those effects would be insignificant and discountable. As we clarified in the amended ITS issued in May 2014, we do not anticipate incidental take of any listed whales due to any activities considered in the 2010 Opinion. Based on our review here, the proposed changes to the action will not result in any effects to listed whales or sea turtles or any critical habitat not considered in the 2010 Opinion. Our conclusions regarding the amount or extent of anticipated incidental take remain the same.

Based on this analysis, we have determined that reinitiation of consultation is not necessary. As such, the conclusions reached in our December 30, 2010 Opinion remain valid and no further consultation is necessary at this time. We look forward to continuing to work cooperatively with your office as the Cape Wind project moves forward. For further information regarding any consultation requirements, please contact Julie Crocker of my staff at (978)282-8480 or by e-mail (Julie.Crocker@noaa.gov).

Sincerely,

John K. Bullard
for
Regional Administrator

Ec: Boelke – F/NER4
USACE
EPA
DOE

File Code: Section 7 BOEM – Cape Wind Reinitiation Review
PCTS: NER-2010-3866

Literature Cited

Bartol, S.M., J.A. Musick, and M. Lenhardt. 1999. Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). Copeia 99(3):836-840.

de Neef, L., P. Middendorp and J. Bakker. 2013. Installation of Monopiles by Vibrohammers for the Riffgat Project. Pfahlsymposium, Braunschweig. http://www.allnamics.eu/wp-content/uploads/Riffgat_Pfahlsymposium_2013_de_Neef.pdf

German Federal Agency for Nature Conservation (Bundesamt für Naturschutz), 2013: Development of Noise Mitigation Measures in Offshore Wind Farm Construction. http://www.cbd.int/doc/meetings/mar/mcbem-2014-01/other/mcbem-2014-01- submission-noise-mitigation-en.pdf

Ketten, D.R. 1998. Marine mammal auditory systems: A summary of audiometric and anatopical data and its implications for underwater acoustic impacts. NOAA Technical Memorandum NMFS-SWFSC-256:1-74.

Lenhardt, M.L., Bellmund, S., Byles, R.A., Harkins, S.W. and Musick, J.A. 1983. Marine Turtle reception of bone conducted sound. Journal of Auditory Research 23: 119–1125.

Lenhardt, M.L. 1994. Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (*Caretta caretta*). In Bjorndal, K.A., A.B. Dolten, D.A. Johnson, and P.J. Eliazar (Compilers). Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, 323 pp.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys – a study of environmental implications. *APPEA Journal*. 40:692–708.

O'Hara, J. & J.R. Wilcox. 1990. Avoidance responses of loggerhead turtles, *Caretta caretta*, to low frequency sound. Copeia 1990: 564-567.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. *Marine Mammals and Noise*. New York: Academic Press.

Ridgway, S.H., E.G. Wever, J.G. McCormick, J. Palin & J.H. Anderson. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. Proceedings of the National Academy of Sciences USA 64: 884-890.

RWE Innogy. 2014. Pilot project has started: Vibratory driving of monopiles can cut costs of offshore wind energy. https://www.rwe.com/web/cms/en/86182/rwe- innogy/news-press/press-release-09-july-2013-export-cables-in-at-gwynt-y-mr-offshore- wind-farm/?pmid=4010871

Stokes, A., K. Cockrell, J. Wilson, D. Davis and D. Warwick. 2010. Mitigation of Underwater Pile Driving Noise During Offshore Construction: Final Report. Department of Interior, Minerals Management Service. Report Number M09PC00019-8. 104 pp.

Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2014. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2013. NOAA Tech Memo NMFS NE 223; 419 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2013. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2012. NOAA Tech Memo NMFS NE 223; 419 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2012. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2011. NOAA Tech Memo NMFS NE 223; 419 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2011. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2010. NOAA Tech Memo NMFS NE 223; 419 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/